

# FROM SEA TO ~~SHINING~~ SPRAWLING SEA

Quantifying the Loss of Open Space in America

By Leon Kolankiewicz, with Roy Beck and Eric A. Ruark

MARCH 2022

 NumbersUSA

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**DISCLAIMER:** The views expressed in this report do not necessarily reflect the official position of NumbersUSA



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## QUANTIFYING THE LOSS OF OPEN SPACE IN AMERICA

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## EXECUTIVE SUMMARY

“30x30” movements around the world are pressing national governments to ensure that 30 percent of their land masses are protected from development by 2030. The more-ambitious “Nature Needs Half” movement argues for stopping the destruction of natural habitat before the ratio falls below 50 percent (already too late for many countries).

**This study examines the powerful counterforce of urban sprawl in the United States.** The good news is that the rapacious rate of open space destruction of the 1980s and 1990s has slowed considerably. But urban sprawl continues to apply the chainsaw and bulldozer blades to vast amounts of rural land each year.

Between 2002 and 2017 (the period of the most recent government data), the federal Natural Resources Conservation Service identified around **17,800 square miles** of new sprawl. (We use the term “sprawl” in the precise way of all our reports since 2000: “Sprawl” is the *amount* of rural land lost to development, regardless of its attractiveness or density.) That means 17,800 square miles of natural and agricultural land were converted during that period into developed land for residential, commercial, industrial, transportation, and other purposes.

Our study calculated that the cause of the 2002-2017 land loss fell into a surprisingly neat 2-to-1 ratio between the two overall factors of sprawl:

- **67% of rural land loss was related to POPULATION GROWTH:** About **11,950 square miles** of rural land were developed to handle the additional consumption needs caused by the U.S. population having **37 million more people** in 2017 than in 2002. Net foreign in-migration was the cause of most population growth, although its role can differ significantly from state to state.
- **33% of rural land loss was related to GROWTH OF DEVELOPED LAND PER RESIDENT resulting from ALL OTHER FACTORS:** About **5,850 square miles** of sprawl between 2002 and 2017 were rural land lost because of dozens of factors that increased the average amount of developed land per person in the country. This developed land provides not only the residence for each person but also the share of



**Figure ES-1. Square Miles of National Land Loss Related to Each Sprawl Factor (2002-2017)**

shopping malls, streets, schools, government buildings, utility infrastructure, waste treatment facilities, parking lots, vacation homes, resorts, highways, and places of employment, worship, and entertainment. On average, Americans were still spreading out, although not as much as in the past.



Figure ES-2. Land Loss in Each State and Percent Related to Each Sprawl Factor (2002-2017)

## DENSER LIVING DIDN'T STOP LOSS OF OPEN SPACE AND HABITAT

In the United States, nearly all government efforts to combat sprawl have focused on strategies which primarily seek to create denser settlement by changing land use practices.

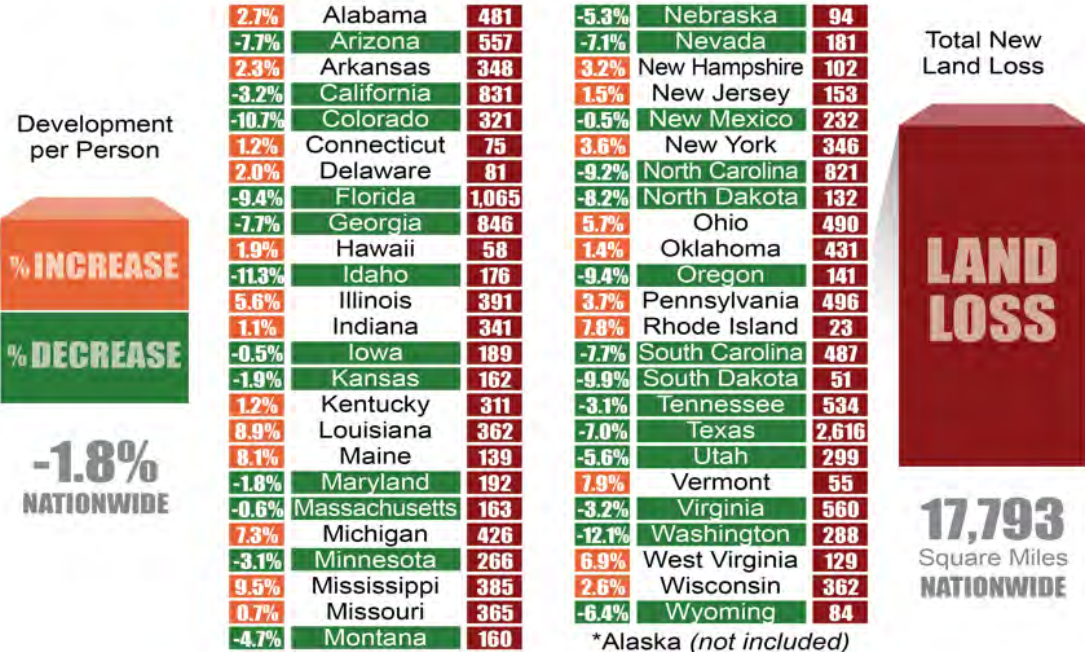
Our findings, however, indicate that approach will have limited success in saving rural land from development because it fails to address the key reason for current sprawl – population growth and its overwhelming driver, federal immigration policies. **Twenty-six states with declining development per resident** in the 2002-2017 period provided case studies for that proposition. The residents of those states lived, worked and shopped more densely than prior to 2002. How did that happen? Certainly, some role was played by so-called Smart Growth planning efforts, higher gasoline prices, fiscal and budgetary constraints (limiting new road-building, for example), the increasing popularity of denser city living (pre-Covid pandemic) and its cultural amenities, and the recession-inducing mortgage meltdown in 2008.

The extent to which any of those and still other unforeseen factors and events – such as the COVID-19 pandemic of 2020-2022 – may affect the rate of per capita sprawl in the coming

decades is unknown and unpredictable. It may well be, for example, that concerns about high density residential living in the face of pandemics could increase sprawl pressures by raising the preference of consumers for lower-density suburban neighborhoods.

The 26 states with declining development per person are shown in **Figure ES-3** with negative percentage numbers in green-shaded boxes. As you can see in the column next to them containing the square miles of lost rural land, all 26 states still sprawled over additional large areas of natural habitat and farmland. **The population growth in these states simply erased any land-conservation benefit of denser living and better planning.**

### Change in Land Use Per Person & Total Land Loss



**Figure ES-3. Change By State in Land Use Per Person & Total Land Loss (2002-2017)**

Even if all new population could somehow be added to cities without the cities expanding over any new ground, the additional people would still greatly increase the overall **ecological footprint** of the cities into rural areas. For example, U.S. residents in 2017 on average used or “consumed” 0.356 acre – a little over one-third of an acre – of developed land per resident. But that 0.356-acre/resident metric does not include relatively unpopulated rural lands – farmlands (cropland, pasture, and rangeland), forests, reservoirs, and mines – that furnish crucial raw materials and products used by every consumer/resident, namely for food, fiber, fuels, water, energy, metals, and minerals. Nor does the 0.356-acre of developed land include the forestlands needed to absorb each American resident’s carbon dioxide (CO<sub>2</sub>) emissions from fossil fuel combustion to produce electricity and propel our vehicles.

All of these ecologically productive lands not covered with pavement and buildings, but used indirectly by each and every U.S. resident (and all human consumers), contribute to the average

per capita ecological footprint of each American. This entails approximately 20 acres per person, according to the Global Footprint Network.



Figure ES-4. Our Ecological Footprint

## POPULATION GROWTH SLOWED BUT NOT BY NEARLY ENOUGH TO STOP SPRAWL

One promising trend in slowing destruction of natural habitat and farmland is that U.S. population growth slowed some toward the end of the study period. Furthermore, there has been much publicity about what may have been a dramatic drop in population expansion in 2019 and 2020, although some of the data remains speculative. Both net migration and fertility rates declined, probably due in large part to the Covid pandemic. But migration rates increased rapidly in 2021, and it remains to be seen if fertility rates will rise back to pre-pandemic levels once the health crisis has subsided.

Even if the loss of habitat and farmland continues at the lower rate of the 2002-2017 period, the average destruction of 1,200 square miles per year would be unsustainable for a country that desires the continued capability of food independence and stewardship of the animal and plant life currently living within its borders.

By 2060, less than 40 years from now, the U.S. Census Bureau projects that the U.S. population will have grown from 330+ million today to 404 million Americans. This is an increase of approximately 70 million over four decades, or about 18 million per decade.

That projection is significantly less than the population expansion in previous decades. But for us as conservationists, 18 million new residents straining our natural resources and environment every decade is still a long way from the crucial **goal of U.S. population stabilization established in 1996** by the President Clinton-appointed sustainability commission’s Task Force on Population and Consumption.

The almost panic-stricken reaction of pundits, politicians, and the media to news that the U.S. population grew by “only” 23 million in the 2010 to 2020 decade has led to calls from much of the American establishment to do everything in its power to postpone or try to prevent U.S. population stabilization by increasing immigration and encouraging American women to have more children.

## FEDERAL CONSERVATION AND POPULATION POLICIES AT ODDS

In May 2021, the Biden Administration formally released its grand “30x30” plan in a report called “[Conserving and Restoring America the Beautiful](#).” Co-authored by the U.S. Departments of Interior, Commerce, and Agriculture, along with the White House Council on Environmental Quality, the document characterizes itself stirringly as a “preliminary report to the National Climate Task Force recommending a ten-year, locally led campaign to conserve and restore the lands and waters upon which we all depend, and which bind us together as Americans.”

The elevated public attention to habitat preservation is a welcome change from the basic disinterest shown during most of our two decades of publishing these sprawl studies. Among many threats to wildlife, including pollution, toxics, invasive species, road mortality, overhunting, or poaching, various studies have found habitat loss is the single most critical threat to the preservation of species.

Preserving natural areas is also important for the quality of life of humans. The presence of open space within and adjacent to our urban areas – and the assurance that this open space will outlast us – serves to counterbalance the stress and strain of modern life. Contact with nature and open space provides both physiological and psychological benefits.

*Nonetheless, many of the same politicians and groups who are ambitiously calling for protecting 30 percent of the United States land area from development by 2030 are also advocating large increases in immigration that would swell the U.S. population even further.*

*Most fail to even recognize that U.S. population growth is a major factor in causing the loss of open space and natural habitat in the United States. The White House “30×30” plan, for example, does not have a single reference to U.S. population growth.*

That approach doesn't work, according to Joseph Chaimie, former director of the United Nations Population Division. Writing in early 2022 in *The Hill*, a favorite publication for those who work in and around Congress, he stated: "If the United States intends to address climate change, biodiversity loss, pollution, etc., it must consider how its population affects each issue."

He lamented that federal officials for a half-century have ignored the recommendations of a bi-partisan federal commission in 1972 to stabilize the U.S. population to reduce pressures on the environment. That failure has had global demographic and environmental consequences. But the United States has a chance to redeem itself: "Gradually stabilizing America's population will provide an exemplary model for other countries to emulate. Rather than racing to increase the size of their respective populations in a world with 8 billion humans and growing, nations would see America moving away from the unsustainable demographic strategy," Chamie wrote.

Congress missed a similar opportunity a quarter-century ago, Gary Wockner wrote in the *Las Vegas Sun*. The Colorado-based, self-proclaimed "river warrior" recognized for efforts to save wild waterways in many countries decried the failure of federal officials to heed the conclusion in 1996 of President Clinton's Task Force on Population and Consumption that U.S. population stabilization is essential for environmental sustainability. "Time is running out, but we can make sure the next three decades don't mirror the past 30 years of population growth and environmental destruction," he wrote. "President Joe Biden has an opportunity to follow in Clinton's footsteps and finally implement the council's recommendations. Our most pristine and breathtaking places are worth protecting. But we won't be able to save them if our country keeps growing by leaps and bounds."

*The United States has lost well over 20,000 square miles of natural habitat and farmland to development since we at the NumbersUSA Education and Research Foundation began our long series of sprawl studies in the year 2000. The losses have exceeded 35,000 square miles since 1996 when the economic, government, private sector, and environmental leaders on the Clinton task force called on the country to "move toward stabilizing the U.S. population."*

At the time of the report, the U.S. population had exceeded **281 million**. The task force warned that if the country did not heed its recommendations, "U.S. population is likely to reach **350 million** by the year 2030; a level that would place even greater strain on our ability to increase prosperity, clean up pollution, alleviate congestion, manage sprawl, and reduce the overall consumption of resources."

Unfortunately, the task force's dismal warning is turning out to be largely precise. U.S. population has already exceeded **332 million** in 2022 and is headed for **355 million** by 2030, according to the Census Bureau. The imperiled natural habitat, species, and human communities are reviewed in the opening chapters of our study.

Today's urgent national efforts, such as the 30x30 movement, are based on changing the trajectory of open-space loss by 2030 without changing the trajectory of population growth. Echoing the conclusions of the Clinton task force, our latest national sprawl study finds that formula is highly unlikely to be successful.

The outlook for open-space conservation could be much more positive, however, if Congress Simply would follow the Clinton task force recommendation to adopt annual immigration numerical caps consistent with the goal of stabilizing the country's population size.

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## QUANTIFYING THE LOSS OF OPEN SPACE IN AMERICA

### 1. **SPRAWL'S TOLL ON THE LANDSCAPES, ECOSYSTEMS AND THE HUMAN SPIRIT OF AMERICA**

#### **1.1 A Special Silver Anniversary**

2021 marked a number of anniversaries and near-anniversaries in the annals of political and scholarly endeavors to understand and oppose human population growth's increasing encroachment on the environment. It marked two decades since NumbersUSA began our long-running series of national, regional, and state-level studies investigating the role of our nation's persistent population growth in accelerating urban sprawl. And it marked approximately a half-century since the founding of Earth Day, when the population growth factor as a force multiplier of environmental impacts was virtually unchallenged – widely accepted by politicians, environmentalists, and scientists alike.

2021 also marked the quarter-century, silver anniversary of the last high-profile, official government recognition that halting U.S. population growth (population stabilization) needs to be an integral part of any successful policy to safeguard and sustain America's environment and natural resources. The year 1996 is when the Clinton White House released the findings of the Population and Consumption Task Force, part of the efforts of the President's Council on Sustainable Development (PCSD).<sup>1</sup>

President Bill Clinton established the PCSD early (1993) in his first term because he was inspired by the U.N. Conference on Environment and Development<sup>2</sup> held in Rio de Janeiro, Brazil in June 1992, when Clinton was still a candidate. Dubbed the "Earth Summit," this landmark gathering was attended by 38,000 people, including, famously, the leaders of 130 countries (among them U.S. President George H.W. Bush) – more heads of state than any prior event in world history (**Figure 1**).

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<sup>1</sup> President's Council on Sustainable Development, Task Force on Population and Consumption. 1996. Available online at: <https://clintonwhitehouse5.archives.gov/PCSD/Publications/index.html>.

<sup>2</sup> United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 3-14 June 1992. See <https://www.un.org/en/conferences/environment/rio1992>.



**Figure 1. United Nations Conference on Environment and Development (dubbed the “Earth Summit”), 1992**

The Earth Summit and the earlier (1987) Brundtland Commission<sup>3</sup> popularized the concept of “sustainable development,” which was defined as meeting the needs of the present without compromising the ability of the future to meet its own needs. In other words, it was unacceptable for our current generation to mindlessly deplete natural resources and pollute the planet in the here-and-now, while thoughtlessly leaving future generations to fend for themselves on a depleted, polluted planet.

President Clinton’s PCSD was a bipartisan group of 25 leaders appointed from government, industry, and NGOs, organized into eight task forces. Each task force addressed various facets of the broad sustainability agenda and drafted recommendations for a National Sustainable Development Action Strategy. The Population and Consumption Task Force, created in 1994, was one of those eight subgroups and its final report was part of that Action Strategy.

Nine members of the Population and Consumption Task Force also served on the wider PCSD. Two of these nine were prominent Democratic officials: Tim Wirth, a former U.S. Senator from Colorado, and then Under-Secretary for Global Affairs in the State Department, and Ron Brown, Secretary of Commerce. Among the other seven were other high-ranking government officials and senior representatives from industry and prominent environmental NGOs, namely

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<sup>3</sup> World Commission on Environment and Development (Brundtland Commission). 1987. *Our Common Future*. The Brundtland Commission was named for its chairwoman, Gro Harlem Brundtland, Prime Minister of Norway (1981, 1986-89, and 1990-96), and later Director-General of the World Health Organization, 1998-2003.

the Sierra Club, Natural Resources Defense Council, Environmental Defense Fund, and Zero Population Growth.

Another 14 members of the Population and Consumption Task Force were not members of the wider PCSD. These additional members hailed mostly from academia and other NGOs.

In late 1994 and early 1995, the Task Force convened roundtables, soliciting both expert presentations and public comment in Washington, D.C.; Chattanooga, Tennessee; and New York City. It issued its final report and findings in 1996.

The Population and Consumption Task Force's 1996 report concluded that:

“The size of our population and the scale of our consumption are essential determinants of whether or not the United States will be able to achieve sustainability. U.S. population and consumption trends demonstrate that a great deal of work needs to be done.”

In addition, the 1996 report stated unequivocally that:

“the two most important steps the United States must take toward sustainability are: **1) to stabilize U.S. population promptly**; and **2) to move toward greater material and energy efficiency in all production and use of goods and services.**”<sup>4</sup> [emphasis added]

The Task Force report also noted:

“...legal and illegal immigration [are now] now at an all-time high. **This is a sensitive issue, but reducing immigration levels is a necessary part of population stabilization and the drive toward sustainability.** [emphasis added]

When the Task Force released its findings and recommendations in 1996, the U.S. population was estimated at 263 million; today in 2021 it stands at 331 million, **an increase of 68 million Americans, each a user of natural resources and maker of environmental wastes**, by the mere act of living and consuming in a modern, affluent society.

In the quarter-century since the Task Force admonished America to stabilize its population, U.S. population growth has averaged 2.7 million per year, or 27 million per decade. Clearly its findings and recommendations fell on deaf ears. Indeed, two of the national environmental community's leading voices on population – the Sierra Club and Zero Population Growth, both of which actually participated in the Task Force – were making it abundantly clear they

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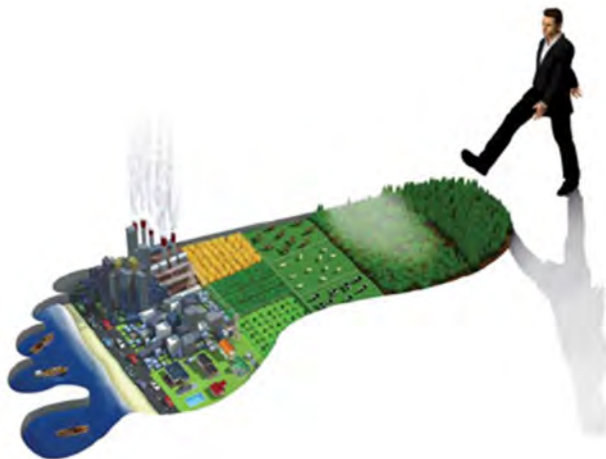
<sup>4</sup> President's Council on Sustainable Development, Task Force on Population and Consumption. 1996. Executive Summary. Available online at: <https://clintonwhitehouse5.archives.gov/PCSD/Publications/index.html>

wanted nothing to do with calls for lower immigration levels, even when those calls emanated from a Democratic administration.

## 1.2 30 x 30...with 38,000,000 and 370,000,000?

Many of the same politicians and groups who are idealistically calling for protecting 30 percent of the United States land area from development by 2030, just nine years from now, are at the same time pushing for “immigration reform” that would add nearly 40 million residents and resource consumers to the U.S. population over the coming decade.<sup>5</sup> This would boost our numbers from about 330 million at present to nearly 370 million. This same dubious “reform” would guarantee that subsequent decades continue to experience massive, unending flows of immigration for as far as the eye can see or demographers can project, all the way to 2100 and beyond. The U.S. population would grow precipitously and demographic pressures on the landscape would increase proportionately.

All human beings and every American – even those who are conscientious and profess to be environmentally aware – inexorably impose certain demands (or what ecologists call a “load”) on the land and resources of the biosphere through consumption and waste generation (including carbon dioxide). The mere act of living with the comforts and conveniences of the modern world necessarily causes environmental impacts, which can be reduced through better technologies and more environmentally enlightened behaviors and virtues, but never entirely eliminated. No amount of wishful thinking or technical wizardry will ever erase our ecological footprint completely (**Figures 2 and 3**).



**Figure 2. Every human being has an ecological footprint, imposing an environmental load on the ecosystems and renewable and nonrenewable natural resources of the biosphere**

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<sup>5</sup> Michael D. Shear and Zolan Kanno-Youngs. 2021. Biden aims to rebuild and expand legal immigration *New York Times*. May 31; Leon Kolankiewicz. 2021. Woke Dems and Enviros Scoff at Original Earth Day Concern: Population Growth. *Townhall*. April 20. Accessed online 5-31-2021 at: <https://townhall.com/columnists/leonkolankiewicz/2021/04/20/woke-dems-and-enviros-scoff-at-original-earth-day-concern-population-growth-n2588176> .



**Figure 3. Heavy per capita use of natural resources in high-consumption, affluent societies results in each consumer becoming, in effect, a “Bigfoot” in terms of his or her ecological footprint**

In view of this reality, are these advocates of endless U.S. population growth via mass immigration – who also profess to be staunch defenders of land and biodiversity – deluding themselves and the American public? Is endless U.S. population growth – and the nonstop additional development it would inevitably entail – compatible with redoubled efforts that actually succeed in conserving increasing amounts of open space and natural habitats? The iconic conservationists and environmentalists – such as David Brower, Gaylord Nelson, Stewart Udall, Paul Watson, and Dave Foreman – who founded and galvanized the modern environmental movement half a century and more ago clearly did not believe so, but today’s more enlightened environmentalists act as if they know better.

In May 2020, the Biden Administration formally released its grand vision to conserve “at least” 30 percent of America’s land and waters by 2030 in a report called “Conserving and Restoring America the Beautiful.”<sup>6</sup> Co-authored by the U.S. Departments of Interior, Commerce, and Agriculture, along with the White House Council on Environmental Quality, the document characterizes itself stirringly as a “preliminary report to the National Climate Task Force recommending a ten-year, locally led campaign to conserve and restore the lands and waters upon which we all depend, and which bind us together as Americans.”

The Biden Administration places the 30 percent land and water conservation goal firmly in the context of the administration’s wider pursuit of solutions to the “climate crisis” and environmental justice, all while “growing our economy”:

<sup>6</sup> U.S. Department of the Interior, U.S. Department of Commerce, U.S. Department of Agriculture, President’s Council on Environmental Quality. 2021. Conserving and Restoring America the Beautiful. Available online at: <https://www.doi.gov/sites/doi.gov/files/report-conserving-and-restoring-america-the-beautiful-2021.pdf>.

This report is a first step toward developing a national conservation effort that reflects the President's ambition, his determination to combat the climate crisis and address environmental injustice while also growing our economy, and his commitment to listening, learning, and supporting the extraordinary conservation work that is already underway across America. [p. 11]

The report never once cites increased land and environmental demands from incessant human population growth in the United States as an impediment to achieving its land and water conservation goal. While the word “population” is mentioned several times, it is only with reference to wildlife and fish populations, not human population size and growth. Population stabilization is mentioned once, but with regard to stabilizing the populations of wildlife species at most at risk of extinction in the near future.

The complete absence of any acknowledgement of human population growth in this report raises suspicion that population is being deliberately elided rather than recognized as a factor in land conservation. Today only about 12 percent of the U.S. land area enjoys some form of protection, as does 26 percent of the area of ocean under American jurisdiction.<sup>7</sup> The 12 percent figure is the result of two centuries of interaction between demographic, conservation, economic development, and market forces. In one sense, the idea that the aggregate area of conserved lands can be almost tripled almost overnight (in under a decade) from 12 to 30% – to an area equal to twice the size of Texas – seems utterly far-fetched. It would require enormous and unprecedented participation by millions of private and rural landowners, who collectively own about 60 percent of the land in the United States. These are the same proud, independent Americans who have always been skeptical, if not downright suspicious of and hostile towards, federal government initiatives and programs that smack of controlling their freedom to use their properties and the natural resources on those properties as they see fit.

Yet at the same time, the 30 percent conservation goal is framed vaguely enough for bureaucrats and activists to ensure it is attainable even with the conversion and development of more than 10 million additional acres of rural lands and natural habitats during the decade of the 2020s to accommodate projected population growth and related urban sprawl.

In 2018, a paper in *Science Advances* by a team of scientists tried to quantify what 21 types of “interventions” on America’s natural and agricultural lands could accomplish on behalf of carbon sequestration and reducing or slowing the increase of carbon emissions as part of multi-pronged national campaign to contribute to the global war on climate change.<sup>8</sup> At least two of those interventions bear examination because of their explicit connection to population growth:

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<sup>7</sup> Bruce Lieberman. 2021. Details behind Biden’s ‘30 by 30’ U.S. lands and oceans climate goal. Yale Climate Connections. Available online at: <https://yaleclimateconnections.org/2021/03/details-behind-bidens-30-by-30-u-s-lands-and-oceans-climate-goal/>.

<sup>8</sup> Joseph E. Farigone et al. 2018. Natural climate solutions for the United States. *Science Advances*. 14

- **Avoiding conversion of forests to other uses.** The *Science Advances* authors observed that much of the most rapid forest conversion are taking place near growing urban areas, as well as in agricultural areas like the Central Valley of California, where urban growth pressures are also enormous.
- **Avoiding conversions of grasslands to cropland.** Converting natural grasslands to cultivated cropland is of course a result of having to feed larger populations of people and livestock in America and around the globe.



**Figure 4. Bison grazes on rangeland in the American West. The Biden Administration’s 30 x 30 campaign hopes to increase scenes like this, all while accommodating approximately 40 million additional Americans on the landscape in the first decade alone, and many more thereafter.**

At the same time that they are hoping to admit tens of millions more immigrants – spiking faster and unending U.S. population growth – in its campaign to reduce U.S. carbon emissions and combat global warming, the Biden Administration is supporting a vast expansion of renewable energy sources. Because the renewables possess much lower energy density than the fossil fuels they would replace, this would necessitate a huge increase in the presence of solar and wind farms on the American landscape – onto the very same constrained landscape that the administration claims it wants to conserve. These conflicting goals of protecting more land from development and radically increasing renewable energy production are never

acknowledged. The center cannot and will not hold. A comparison recently made by energy expert and systems thinker Nate Hagens, PhD is apropos:

“...a 200-megawatt wind farm might require spreading turbines over 19 square miles. A natural gas power plant with that same generating capacity would fit onto a single city block.”<sup>9</sup>

The Biden Administration’s 30 x 30 plan is considered an interim measure and America’s contribution in the international campaign to drastically increase the share of the landscape dedicated to nature conservation. Ecologists, conservationists, environmental groups, and many others have long pushed for protecting natural habitats – primarily to preserve wilderness and biodiversity. Edward O. Wilson, who died at the end of 2021, advocated in his landmark 2017 book, *Half Earth: Our Planet’s Fight for Life*, that 50 percent of the planet be preserved in its natural condition<sup>10</sup> to forestall the mass extinction of thousands of species, including perhaps our own. In what has been called his most “impassioned” book to date, the eminent entomologist and author argued that humanity must move rapidly to preserve the biodiversity of our ecosphere. In *Half-Earth*, he maintained that our dilemma is too great to be approached in a piecemeal fashion; he thus proposed a solution appropriate to the scale of the problem: dedicating fully half the Earth’s surface area to nature. Conserving thirty percent by 2030 in the United States and elsewhere is thus regarded as an interim goal.

Like the great conservationists cited above, scientist Wilson did not consider perpetual human population growth to be compatible with the preservation of biological diversity. In an earlier (1992) book, *The Diversity of Life*, he wrote: “The raging monster upon the land is population growth. In its presence, sustainability is but a fragile theoretical concept.” In a 2001 *Scientific American* article, Wilson explained: “The pattern of human population growth in the 20th century was more bacterial than primate. When *Homo sapiens* passed the six-billion mark we had already exceeded by perhaps as much as 100 times the biomass of any large animal species that ever existed on the land. We and the rest of life cannot afford another 100 years like that.” Wilson referred to rapid human population growth as “our reproductive folly.”<sup>11</sup>

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<sup>9</sup> Nate Hagens. 2021. Earth and Humanity: Myth and Reality. Myth #21: “Renewables Can Power THIS Civilization. May 16. Available online at: <https://www.youtube.com/watch?v=qYeZwUVx5MY>. At 45:29.

<sup>10</sup> Edward O. Wilson. 2017. *Half Earth: Our Planet’s Fight for Life*. Liveright/W.W. Norton. <https://eowilsonfoundation.org/half-earth-our-planet-s-fight-for-life/>

<sup>11</sup> E.O. Wilson. 2002. The Bottleneck. *Scientific American*, February.

### 1.3 Sprawl Still a Problem After All These Years (and Americans Are Still Concerned)

NumbersUSA published its first national level study on sprawl two decades ago in 2001.<sup>12</sup> At that time, sprawl was a hot topic with many environmental organizations and the general public concerned about the impacts of ever-expanding cities and the nation's steadily disappearing rural land.<sup>13</sup> Vice-president and later presidential candidate Al Gore had made it a personal cause in the late 1990s.<sup>14</sup> Two decades later, sprawl is still devouring valuable farmland and wildlife habitat throughout the United States, but national and state environmental groups, by and large, have shifted their focus away from domestic environmental and conservation issues toward more global issues like global warming and "climate justice".<sup>15</sup> The loss of habitat and open space due to the unsustainable outward expansion of cities in America, i.e., urban and suburban sprawl, has fallen out of fashion; it is no longer seen as "sexy."

Despite our country's economic setbacks since the Great Recession of 2008, sprawl continues to be a major threat to rural land and natural habitats in the United States. Nationally, in just the 10 years from 2007 to 2017, some 5,697,000 acres (about 8,900 square miles) – an area larger than New Jersey (8,723 square miles) – of previously undeveloped land succumbed to the bulldozer's blade.

Although urban sprawl by name is not particularly salient in the news anymore, 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 and would like these unfavorable trends halted or at least curbed. The very first question in a May 2020 survey of 1,500 likely American voters revealed that 79 percent overall thought that the destruction of farmland and natural habitat because of urban sprawl was a "major problem" (44%) or "somewhat of a problem" (35%). In the fourth question of that same poll, when asked if it "is

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<sup>12</sup> 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. NumbersUSA: Arlington, VA. 64 pp. Available at: <https://www.numbersusa.com/content/resources/publications/publications/studies/weighing-sprawl-factors-large-us-cities.html>.

<sup>13</sup> 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.

<sup>14</sup> Terry M. Neal. 1999. Gore Taps Voter Concern on 'Livability.' *Washington Post*. May 5. Available online at: <https://www.washingtonpost.com/wp-srv/politics/campaigns/wh2000/stories/sprawl050599.htm>.

<sup>15</sup> Daisy Simmons. 2020. What is 'climate justice'? It begins with the idea that the adverse effects of a warming climate are not felt equitably among people. *Yale Climate Connections*. July 29. Available online at: <https://yaleclimateconnections.org/2020/07/what-is-climate-justice/>.

unethical to pave over and build on good cropland,” or if “the need to for more housing is a legitimate reason to eliminate cropland,” 62% responded that it is unethical to do so, more than three times the percentage (18%) who thought that the need for more housing is a legitimate reason.<sup>16</sup>

1. The U.S. Department of Agriculture calculates that in recent decades urban sprawl has destroyed 43 million acres of farmland and natural habitat, an area about equal in size to all of New England. If this trend were to continue, would it be a major problem, somewhat of a problem, not much of a problem, or not a problem at all?

44% A major problem  
 35% Somewhat of a problem  
 11% Not much of a problem  
 4% Not a problem at all  
 6% Not sure

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?

62% It is unethical to pave over and build on good cropland  
 18% The need for more housing is a legitimate reason to eliminate cropland  
 20% Not sure

In the 35-year (1982-2017) period measured by the most recent National Resources Inventory (NRI), conducted by the United States Department of Agriculture’s (USDA) Natural Resources Conservation Service (or NRCS, formerly the Soil Conservation Service or SCS), approximately 69,000 square miles (44,175,300 acres) of open space, natural habitats, and farmland in the United States were converted into “Developed Land,” including housing, shopping malls, streets, schools, government buildings, utility infrastructure, waste treatment facilities, parking lots, vacation homes, resorts, highways, and places of work, worship, and entertainment.<sup>17</sup> An area larger than Florida, our 22<sup>nd</sup> largest state, was “paved over” in just 35 years.

By 2017, according to the most recent iteration of the NRI (released in 2020), some 116,303,000 acres of land – 181,723 square miles – in the United States had been developed. This is an area nearly 20,000 square miles larger than the state of California (163,700 square

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<sup>16</sup> Pulse Opinion Research. 2020. National Survey of 1,500 Likely Voters. Conducted May 25-27, 2020. Margin of Sampling Error, +/- 2.5 percentage points with a 95% level of confidence. See Appendix G of this study for entire survey.

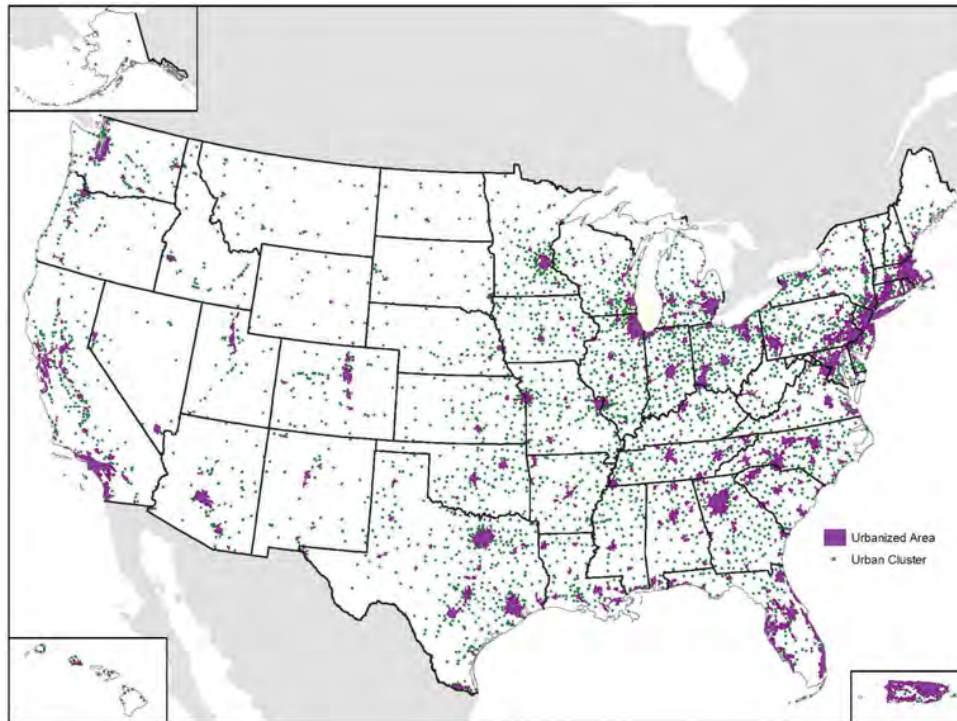
<sup>17</sup> USDA Natural Resources Conservation Service (NRCS). 2020. *2017 National Resources Inventory, Summary Report* (September). Table 1. Available online at: <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/nri/results/>.

miles), our third largest state. Only Alaska and Texas are larger. Another way of conveying the comparative extent of this developed land area is that it is approximately equal to the states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, Delaware, New Jersey, New York, and Pennsylvania combined, that is, all of New England and much of the Mid-Atlantic States. **Figure 5** depicts the approximate area of developed land by coloring these states in red.



**Figure 5. As of 2017, cumulative developed land in the United States is approximately equal to the combined area of those states shown in – Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, Delaware, New Jersey, New York, and Pennsylvania**

Of course, developed lands are not all contiguous in a single blob or polygon covering one part of the country and leaving the rest untouched, but are distributed unevenly in blotches and spots across the landscape from the Atlantic to the Pacific (east to west), and the Gulf of Mexico and Mexican border to the Canadian border (from south to north). **Figure 6** depicts the actual distribution of “urbanized lands” across America in 2010, the most recent year for which such a graphic exists. Urbanized land areas, as defined and delineated for many years by the U.S. Census Bureau, are a similar category to NRI developed lands. The much greater extent of urbanization in the eastern USA and on East and West Coasts is quite evident on this map.

**Figure 6 – Urbanized Areas and Urban Clusters in the United States, 2010**

*Source:* U.S. Census Bureau

We can appreciate the degree to which urbanization has expropriated much of the American landscape by viewing a composite nighttime satellite image of the USA as a whole. Viewing this image (**Figure 7**), one can see why astronomers say that residents of the United States east of the Mississippi River may live out their entire lives without ever once seeing the Milky Way, the galaxy in which we reside. This is due to the combination of the glow and glare from artificial lighting (light pollution) that cloak urbanized areas and the air pollution generated by the traffic, factories, and power plants associated with these areas. In contrast, less densely populated states like Arizona (outside of Phoenix and Tucson), blessed with dark and dry skies at night, away from its urban areas, are a blessing for astronomers and amateur stargazers who want to see, know, and appreciate man’s place in the universe (**Figure 8**).

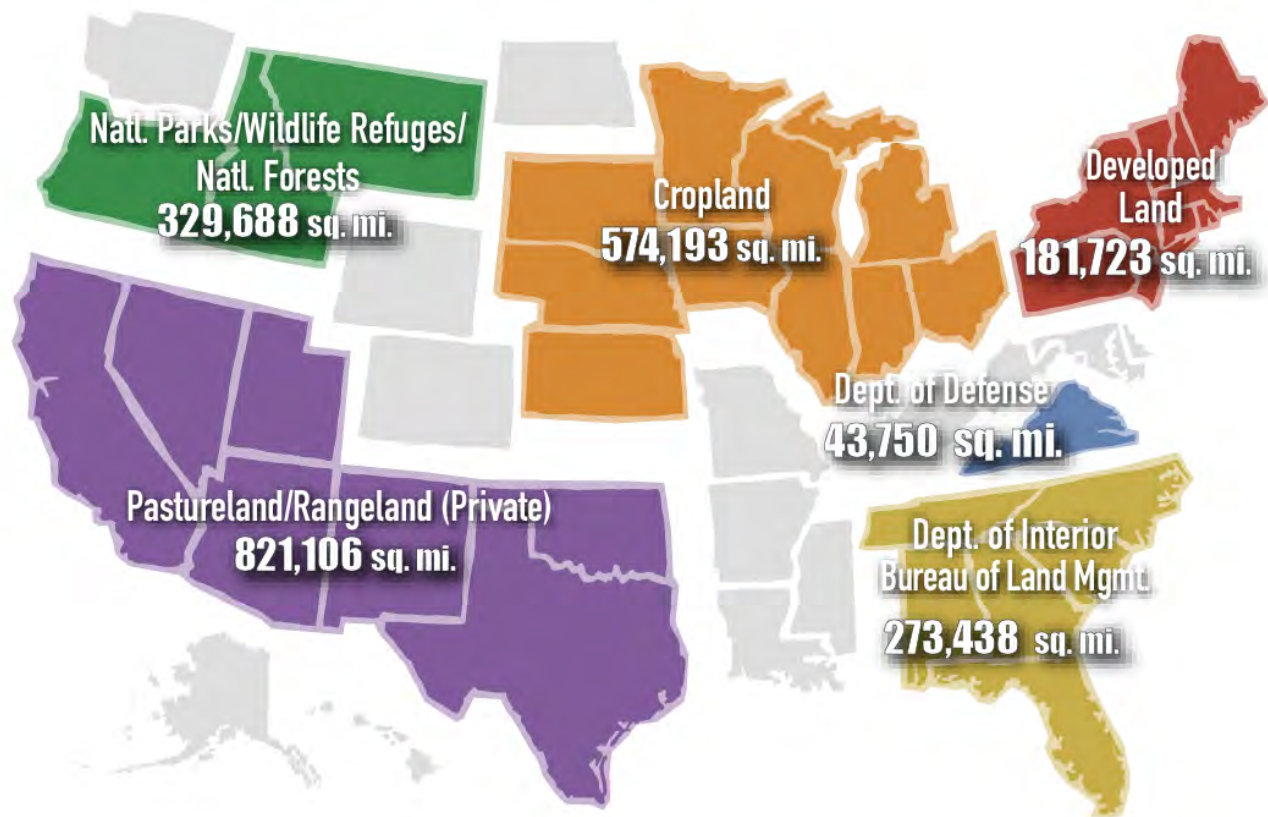
**Figure 5**, depicting all of America’s developed land as a single polygon, may also be misleading or deceptive if it gives the impression that the rest of the country, about 94 percent of it – now undeveloped lands or open space – is simply unused, empty, or wasted land that could be readily urbanized at no cost to society. In fact, most of these lands are already in use, serving valuable functions meeting the needs of urban residents for raw materials, food, fiber, water, watershed protection, energy, carbon sequestration, recreation, energy, and national defense, among other purposes (**Figure 9**).



**Figure 7. Composite Satellite Image of the United States at Night**



**Figure 8. Cactuses point to the Milky Way galaxy in the empty heart of the Arizona desert, far from the “Madding Crowd” and the obnoxious glare of big city lights**



**Figure 9. Equivalent Areas of Cumulative Developed Land (2017) and Other Designated Land Uses\***

*\*not a comprehensive inventory of all other designated and recognized land uses*

**Figure 9**, as noted, is not intended as a comprehensive inventory of all other official, designated, or recognized land uses in the USA. Rather, it is a mix of most public (federal, but not state, county, or local) and private land uses (privately owned cropland, pastureland, rangeland, but not forestland) which furnish Americans with valuable ecological services and economic goods and products. For example, the U.S. Department of the Interior’s Bureau of Land Management manages some 273,438 square miles of land of the Lower 48 States – approximately equal in size to Tennessee, North Carolina, South Carolina, Georgia, Alabama, and Florida. These lands are used for livestock grazing, renewable and nonrenewable energy development, timber harvest, and many forms of outdoor recreation, all while “ensuring natural, cultural, and historic resources are maintained for present and future use,” according to the Bureau. Thus, it is a serious error to think of the approximately 94 percent of the land in the Lower 48 states that is now undeveloped as unused and or useless.

Which states have sprawled the most in recent decades? **Tables 1 and 2** list every state except Alaska. In **Table 1**, for the entire 35-year period of record (1982-2017), Texas, Florida, North Carolina, Georgia, and California are the top 5 sprawlers. Texas alone sprawled over 6,630 square miles in this time period, 52% more than the second-place state, Florida. Texans have witnessed and experienced this explosive growth firsthand.

**Table 1. Sprawl in 49 States, 1982-2017, Ranked by Increase in Land Area**

| <b>Sprawl Ranking<br/>1982-2017</b> | <b>State</b>   | <b>Overall Sprawl (in square<br/>miles), 1982-2017</b> |
|-------------------------------------|----------------|--|
| 1                                   | Texas          | 6,633.8  |
| 2                                   | Florida        | 4,353.0  |
| 3                                   | North Carolina | 3,995.5  |
| 4                                   | Georgia        | 3,910.2  |
| 5                                   | California     | 3,420.5  |
| 6                                   | Pennsylvania   | 2,686.4  |
| 7                                   | Tennessee      | 2,353.9  |
| 8                                   | Michigan       | 2,208.1  |
| 9                                   | Virginia       | 2,179.8  |
| 10                                  | Ohio           | 2,148.8  |
| 11                                  | South Carolina | 2,125.9  |
| 12                                  | Alabama        | 2,023.1  |
| 13                                  | Arizona        | 1,744.1  |
| 14                                  | New York       | 1,608.8  |
| 15                                  | Kentucky       | 1,582.8  |

| <b>Sprawl Ranking<br/>1982-2017</b> | <b>State</b>  | <b>Overall Sprawl (in square<br/>miles), 1982-2017</b> |
|-------------------------------------|---------------|--|
| 16                                  | Washington    | 1,436.1  |
| 17                                  | Illinois      | 1,332.2  |
| 18                                  | Missouri      | 1,328.8  |
| 19                                  | Wisconsin     | 1,261.1  |
| 20                                  | Mississippi   | 1,217.0  |
| 21                                  | Indiana       | 1,203.4  |
| 22                                  | Louisiana     | 1,191.6  |
| 23                                  | Minnesota     | 1,145.9  |
| 24                                  | Oklahoma      | 1,133.4  |
| 25                                  | Colorado      | 1,206.0  |
| 26                                  | New Jersey    | 1,076.7  |
| 27                                  | Massachusetts | 1,038.1  |
| 28                                  | Arkansas      | 1,034.8  |
| 29                                  | New Mexico    | 1,018.6  |
| 30                                  | Maryland      | 877.0  |
| 31                                  | West Virginia | 827.3  |
| 32                                  | Utah          | 712.7  |
| 33                                  | Oregon        | 687.5  |
| 34                                  | Kansas        | 626.9  |

| <b>Sprawl Ranking<br/>1982-2017</b> | <b>State</b>  | <b>Overall Sprawl (in square<br/>miles), 1982-2017</b> |
|-------------------------------------|---------------|--|
| 35                                  | Idaho         | 582.7  |
| 36                                  | Maine         | 581.1  |
| 37                                  | Iowa          | 505.5  |
| 38                                  | Nevada        | 498.8  |
| 39                                  | New Hampshire | 498.6  |
| 40                                  | Montana       | 415.6  |
| 41                                  | Connecticut   | 319.7  |
| 42                                  | Nebraska      | 270.2  |
| 43                                  | South Dakota  | 251.7  |
| 44                                  | Wyoming       | 251.3  |
| 45                                  | North Dakota  | 232.8  |
| 46                                  | Vermont       | 224.1  |
| 47                                  | Delaware      | 216.7  |
| 48                                  | Hawaii        | 136.3  |
| 49                                  | Rhode Island  | 99.1   |
|                                     | <b>Total</b>  | <b>68,334.1</b>  |

*Source: 2017 NRCS National Resources Inventory; Table 1*

**Note:** Includes all states except Alaska; does not include territories



**Figure 10. Urban Sprawl in Houston, Texas**

In **Table 2**, covering the most recent 15-year period, from 2002 to 2017, the top two most-sprawling states, Texas and Florida, maintain their top rankings, followed by Georgia (4<sup>th</sup> place from 1982-2017), California (5<sup>th</sup> place 1982-2017), and North Carolina (3<sup>rd</sup> place, 1982-2017). The top five states over the longer time frame are the same top five states in the most recent 15-year period, but with some shuffling of places. Once again, Texas was far and away the most sprawling state, with more than twice the area paved over with pavement than the 2<sup>nd</sup>-place state, Florida.

**Table 2. Recent Sprawl in 49 States, 2002-2017, Ranked by Increase in Land Area**

| Sprawl Ranking<br>2002-2017 | State          | Overall Sprawl (in square miles),<br>2002-2017 |
|-----------------------------|----------------|--|
| 1                           | Texas          | 2,616.3  |
| 2                           | Florida        | 1,065.3  |
| 3                           | Georgia        | 846.4  |
| 4                           | California     | 830.9  |
| 5                           | North Carolina | 820.9  |
| 6                           | Virginia       | 559.5  |

| <b>Sprawl Ranking<br/>2002-2017</b> | <b>State</b>   | <b>Overall Sprawl (in square miles),<br/>2002-2017</b> |
|-------------------------------------|----------------|--|
| 7                                   | Arizona        | 556.7  |
| 8                                   | Tennessee      | 533.8  |
| 9                                   | Pennsylvania   | 496.3  |
| 10                                  | Ohio           | 490.3  |
| 11                                  | South Carolina | 485.8  |
| 12                                  | Alabama        | 480.6  |
| 13                                  | Oklahoma       | 430.5  |
| 14                                  | Michigan       | 425.6  |
| 15                                  | Illinois       | 390.5  |
| 16                                  | Mississippi    | 384.7  |
| 17                                  | Missouri       | 364.7  |
| 18                                  | Wisconsin      | 362.0  |
| 19                                  | Louisiana      | 361.9  |
| 20                                  | Arkansas       | 348.1  |
| 21                                  | New York       | 344.1  |
| 22                                  | Indiana        | 341.3  |
| 23                                  | Kentucky       | 310.5  |
| 24                                  | Utah           | 298.9  |
| 25                                  | Washington     | 287.7  |
| 26                                  | Colorado       | 287.5  |
| 27                                  | Minnesota      | 265.6  |
| 28                                  | New Mexico     | 232.0  |

| <b>Sprawl Ranking<br/>2002-2017</b> | <b>State</b>  | <b>Overall Sprawl (in square miles),<br/>2002-2017</b> |
|-------------------------------------|---------------|--|
| 29                                  | Maryland      | 191.6  |
| 30                                  | Iowa          | 188.8  |
| 31                                  | Idaho         | 175.8  |
| 32                                  | Nevada        | 173.3  |
| 33                                  | Massachusetts | 163.0  |
| 34                                  | Kansas        | 162.3  |
| 35                                  | Montana       | 159.7  |
| 36                                  | New Jersey    | 152.5  |
| 37                                  | Oregon        | 141.4  |
| 38                                  | Maine         | 138.9  |
| 39                                  | North Dakota  | 131.6  |
| 40                                  | West Virginia | 129.2  |
| 41                                  | New Hampshire | 94.5   |
| 42                                  | Nebraska      | 93.8   |
| 43                                  | Wyoming       | 83.9   |
| 44                                  | Delaware      | 81.1   |
| 45                                  | Connecticut   | 65.9   |
| 46                                  | Hawaii        | 57.5   |
| 47                                  | Vermont       | 55.0   |

| <b>Sprawl Ranking<br/>2002-2017</b> | <b>State</b> | <b>Overall Sprawl (in square miles),<br/>2002-2017</b> |
|-------------------------------------|--------------|--|
| 48                                  | South Dakota | 51.3   |
| 49                                  | Rhode Island | 23.3   |
|                                     | <b>Total</b> | <b>11,944.9</b>  |

*Source: 2017 NRCS National Resources Inventory; Table 1*

**Note:** Includes all states except Alaska; does not include territories

How much total development was there by 2017? **Table 3** ranks the contiguous 48 states plus Hawaii by the cumulative total area of developed land in the state. That is, the numbers in this table include the area of sprawl that occurred from 1982 to 2017 (shown in **Table 1**), plus all land development that took place prior to 1982.

**Table 3. Cumulative Development in 49 States,  
Ranked by Total Developed Land Area in 2017**

| <b>Cumulative Sprawl<br/>Ranking</b> | <b>State</b>   | <b>Cumulative Sprawl (square<br/>miles) in 2017</b> |
|--------------------------------------|----------------|---|
| 1                                    | Texas          | 14,891  |
| 2                                    | California     | 9,822   |
| 3                                    | Florida        | 8,750   |
| 4                                    | North Carolina | 7,681   |
| 5                                    | Georgia        | 7,390   |
| 6                                    | Pennsylvania   | 7,045   |
| 7                                    | Michigan       | 6,610   |
| 8                                    | Ohio           | 6,601   |
| 9                                    | New York       | 6,083   |
| 10                                   | Illinois       | 5,447   |
| 11                                   | Virginia       | 5,052   |
| 12                                   | Tennessee      | 4,924   |

| <b>Cumulative Sprawl Ranking</b> | <b>State</b>   | <b>Cumulative Sprawl (square miles) in 2017</b> |
|----------------------------------|----------------|---|
| 13                               | Missouri       | 4,717   |
| 14                               | Alabama        | 4,588   |
| 15                               | Wisconsin      | 4,360   |
| 16                               | South Carolina | 4,269   |
| 17                               | Indiana        | 3,999   |
| 18                               | Washington     | 3,951   |
| 19                               | Minnesota      | 3,845   |
| 20                               | Oklahoma       | 3,454   |
| 21                               | Kentucky       | 3,352   |
| 22                               | Kansas         | 3,338   |
| 23                               | Arizona        | 3,280   |
| 24                               | Louisiana      | 3,122   |
| 25                               | Colorado       | 3,084   |
| 26                               | Iowa           | 3,069   |
| 27                               | Mississippi    | 3,045   |
| 28                               | Arkansas       | 2,940   |
| 29                               | New Jersey     | 2,925   |
| 30                               | Massachusetts  | 2,776   |
| 31                               | Maryland       | 2,398   |
| 32                               | Oregon         | 2,212   |
| 33                               | New Mexico     | 2,141   |
| 34                               | Nebraska       | 1,981   |
| 35                               | West Virginia  | 1,824   |
| 36                               | Montana        | 1,749   |

| Cumulative Sprawl Ranking | State               | Cumulative Sprawl (square miles) in 2017 |
|---------------------------|---------------------|--|
| 37                        | Connecticut         | 1,701                                    |
| 38                        | North Dakota        | 1,652                                    |
| 39                        | South Dakota        | 1,525                                    |
| 40                        | Idaho               | 1,458                                    |
| 41                        | Utah                | 1,451                                    |
| 42                        | Maine               | 1,368                                    |
| 43                        | New Hampshire       | 1,152                                    |
| 44                        | Wyoming             | 1,088                                    |
| 45                        | Nevada              | 850                                      |
| 46                        | Vermont             | 636                                      |
| 47                        | Delaware            | 466                                      |
| 48                        | Hawaii              | 393                                      |
| 49                        | Rhode Island        | 367                                      |
|                           | <b>Total Sprawl</b> | <b>179,807.3</b>                         |

*Source: 2017 NRCS National Resources Inventory; Table 1*

**Note:** Includes all states except Alaska; does not include territories

Perhaps unsurprisingly, the top five sprawling states to date, that is, those with the most cumulative sprawl or area of developed land as of 2017, are the same five states that shared the top five rankings for the most amount of sprawl from 1982 to 2017 and 2002 to 2017: Texas, California, Florida, North Carolina, and Georgia, in that order. The alert reader will perhaps grasp that these same five states have something else in common as well, which subsequent sections of this report will delve into.

Also unsurprisingly, with one exception, the five states with the least cumulative amount of sprawl and development by 2017 were Rhode Island, Hawaii, Delaware, Vermont, and Nevada. Four of these five are small northeastern states with a small land area, so that smaller amounts of total developed land are to be expected. Nevada, in contrast, is a large state (110,572 square miles, 7<sup>th</sup> largest), and until recent decades, was a small, Southwestern, extremely arid state, whose growth and development was only made possible by

hydroelectricity and water from the Hoover Dam on the Colorado River, air conditioning, and gambling.

The rest of this section provides some background on what development sprawl is and what is at stake due to its relentless outward march. Section 2 then describes our methodology, sources and definitions. Section 3 presents our findings.

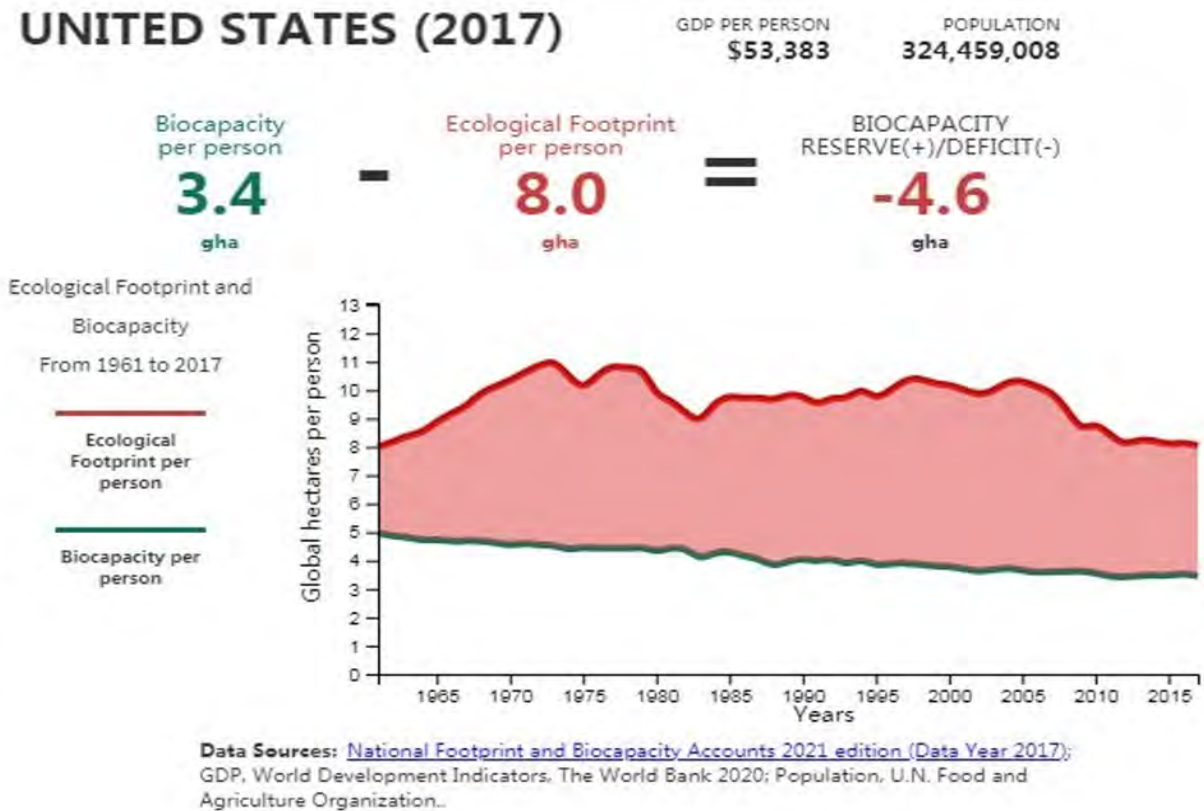
## 1.4 Sprawl versus Ecological Footprint

Developed land includes much more than urban residential areas alone. It also includes other built-up land uses, including transportation, light and heavy industrial, commercial retail and office, institutional, and even urban park space. In 2017, American consumers/residents on average used or “consumed” 0.356 acre of developed land per capita, or a little over one-third of an acre per person. This 0.356-acre/resident metric does not include relatively unpopulated rural lands – farmlands (cropland, pasture, and rangeland), forests, reservoirs, mines – that furnish crucial raw materials and products used by every consumer/resident, namely food, fiber, fuels, water, energy, metals, and minerals.

Nor does it include the forestlands needed to absorb each American resident’s or consumer’s carbon dioxide (CO<sub>2</sub>) emissions from fossil fuel combustion to produce electricity and propel our vehicles. All of these ecologically productive lands not covered with pavement and buildings, but used indirectly by each and every U.S. resident (and all human consumers), contribute to each average American’s per capita ecological footprint. This entails a much larger amount of land, 56 times greater in fact, or approximately 20 global acres (8.0 global hectares) per person, according to the Global Footprint Network (**Figure 11**).<sup>18</sup>

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<sup>18</sup> Global Footprint Network. 2021. Accessed online June 5, 2021 at: <https://data.footprintnetwork.org/#/>



**Figure 11. Per Capita Ecological Footprint of the United States in 2017**

*Source:* Global Footprint Network

In 2017, the United States had a per capita ecological deficit of 4.6 global hectares (one hectare equals 2.47 acres). According to the Global Footprint Network, an ecological deficit occurs when the Ecological Footprint of a given population exceeds the “biocapacity” (ecologically productive lands capable of large-scale photosynthesis) of the area available to that population. A national ecological deficit means that the United States is importing biocapacity through trade, “liquidating” national ecological assets or emitting the CO<sub>2</sub> waste product or “residual” into the atmosphere. (In contrast, an ecological reserve exists when the biocapacity of a region or country exceeds its population's Ecological Footprint.)

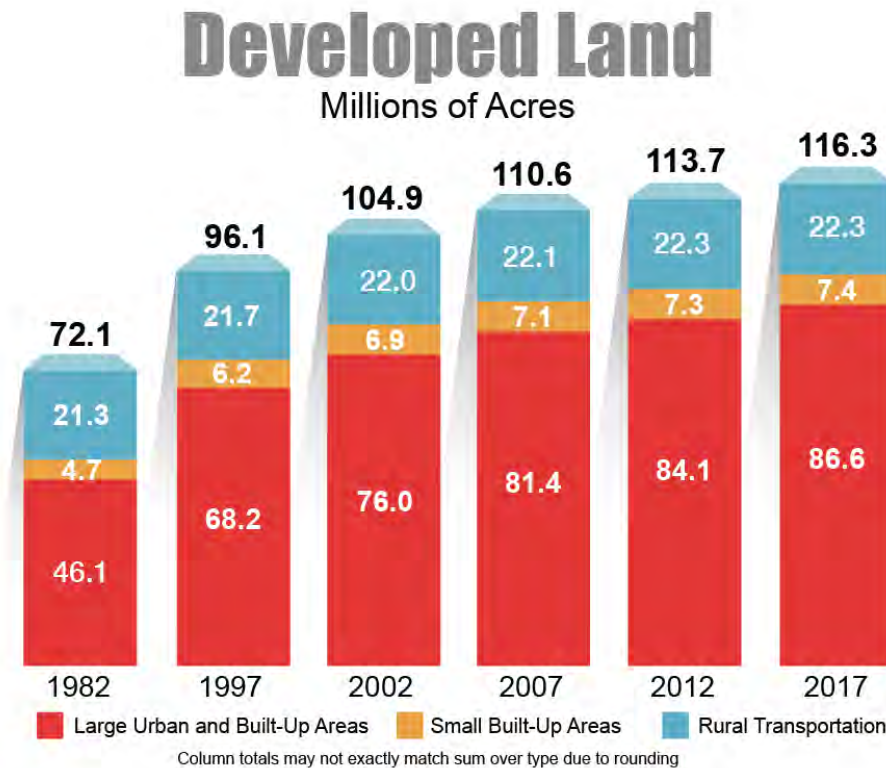
## 1.5 Loss of Farmland, Wildlife Habitat, and Open Space

### 1.5.1 Developing and Losing Farmland

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. As the NRCS put it in the 2007 NRI 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 agricultural land or forest land, is of particular concern due to its potential effect on crop production and wildlife.<sup>19</sup>

Nationwide, from 1982 to 2017, about 69,000 square miles (44,175,300 acres) – an area larger than Florida – of previously undeveloped, non-federal rural land was paved over to accommodate our growing cities and towns (**Figure 12**). The total amount of developed land was 72.1 million acres in 1982. By 2017, this had risen to 116.3 million acres.



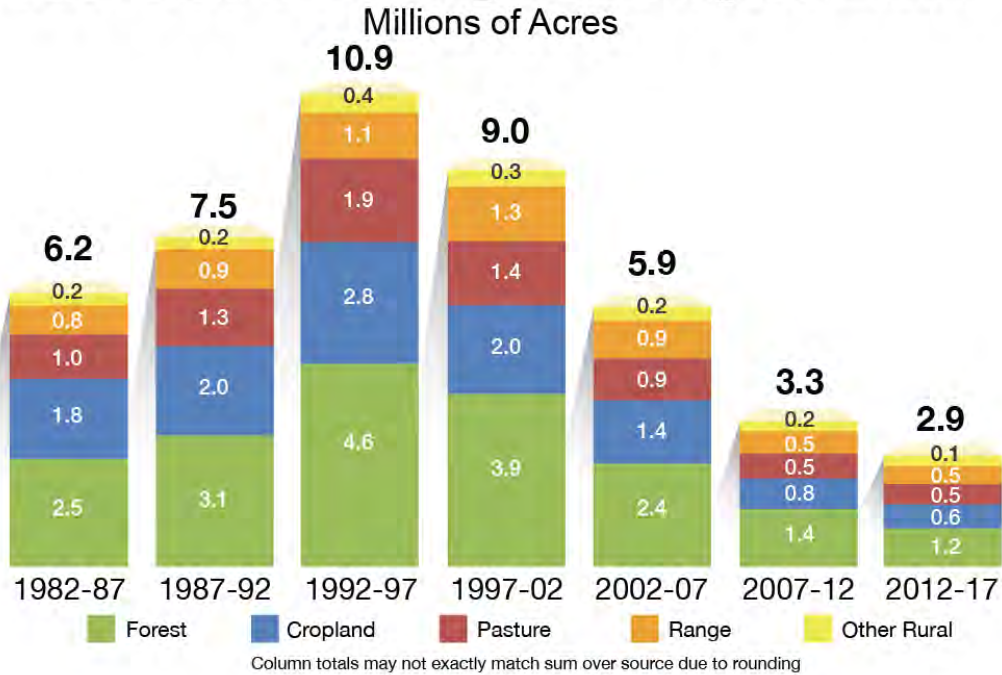
**Figure 12. Cumulative Growth in Area of Developed Land Nationwide, 1982-2017**

*Source: 2017 National Resources Inventory, Summary Report, p. 2-6.*

Where did these developed lands come from? What types of rural land uses were converted into developed land? These are quantified in **Figure 13**, the sources of newly developed land, including cropland, pastureland, rangeland, forestland, and other rural lands.

<sup>19</sup> Natural Resources Conservation Service (NRCS). 2013. 2007 National Resources Inventory: Development of Non-Federal Rural Land. March.

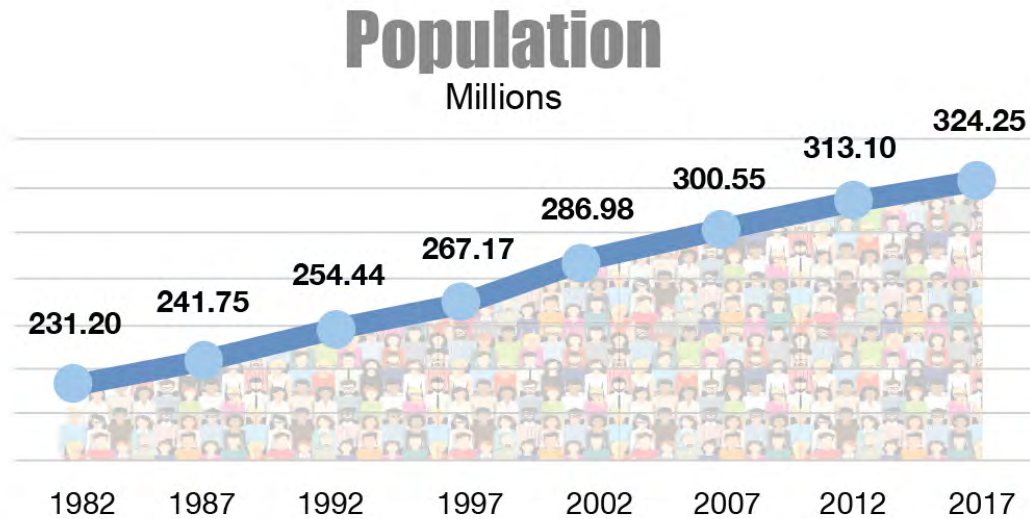
# Sources of Newly Developed Land



**Figure 13. Sources of Newly Developed Land, 1982 to 2017**  
 Source: 2017 National Resources Inventory, Summary Report, p. 2-7.

Of these 44 million acres lost – or “converted” as land managers and planners generally refer to it – approximately 11.1 million acres were cropland, 13.1 million acres were pasture and rangeland, and 18.8 million acres were forestland. “Other Rural” comprised 0.15 acre.

However, “as the population has increased, the acres developed per person has [sic] dropped off.” The five-year period from 1992 to 1997 witnessed the greatest loss of open space because of development, at 10.9 million acres. A decade later, from 2002 to 2007, this figure had dropped by almost half to 5.9 million acres. Population growth at 5-year intervals over the same 35-year time frame is shown by NRCS in **Figure 14**. The U.S. population grew by nearly 90 million during this period, at a rate of about 27 million new residents per decade, a very rapid (and unsustainable) rate of increase that adds nearly a new Texas (our second-most populous state after California) to the U.S. population every decade.



**Figure 14. U.S. Population Growth from 1982 to 2015**

*Source: 2017 National Resources Inventory, Summary Report, p. 2-7 (Footnote #6).*

**Figure 12** shows the increase in the cumulative total of developed land in the United States from 1982 to 2017. By 2017, approximately 116.3 million acres of land (or 181,720 square miles) had been developed in the 48 conterminous states, Hawaii, Puerto Rico, and the U.S. Virgin Islands. Thus, more than one-third (38 percent) of all land developed in our nation's entire history has been developed in just the last 35 years. This is a rapid, accelerating rate of change. If this rate (1.26 million acres developed/year) had persisted for the entire 245-year history of the United States (since 1776), the total area of developed land in the country would be 309 million acres rather than 116 million acres, over two-and-a-half times as much. Another way of stating this is that the annual rate of land development in the U.S. in recent decades is 2.66 times greater than the average rate throughout our history as a country.

As noted above, the aggregate area of developed land in 2017 was about equal in size to the 10 states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, Delaware, New Jersey, New York, and Pennsylvania combined, that is, all of New England and much of the Mid-Atlantic States.

On average, on each of the 12,785 days in the 35 years between 1982 and 2017, approximately 3,455 acres (5.4 square miles) of open space in the United States succumbed to the bulldozer's blade, asphalt, concrete, and buildings. It is noteworthy that the amount of rural land converted to developed land rose and fell significantly during the 35-year time period. It went from 3,301 acres per day in the mid-1980s to a peak of 5,858 acres per day in the mid-1990s, and back down to 1,439 acres per day by 2012 to 2017, a reflection of increasing residential population density and also a response to the Great Recession of 2008 and its aftermath.

**Table 4. Cumulative Increase in Developed Land in the United States, 1982-2017**

| Year           | Area of Developed Land (thousand acres) | Period           | Added annual increment of Developed Land during period (acres) | Average daily amount of land consumed by sprawl during period (acres) |
|----------------|---|------------------|--|---|
| 1982           | 72,127.7                                |                  |  |   |
| 1987           | 78,152.7                                | 1982-1987        | 1,205,000  | 3,301   |
| 1992           | 85,399.2                                | 1987-1992        | 1,449,300  | 3,971   |
| 1997           | 96,090.4                                | 1992-1997        | 2,138,240  | 5,858   |
| 2002           | 104,880.8                               | 1997-2002        | 1,758,080  | 4,817   |
| 2007           | 110,606.1                               | 2002-2007        | 1,145,060  | 3,137   |
| 2012           | 113,676.2                               | 2007-2012        | 614,020  | 1,682   |
| 2017           | 116,303.0                               | 2012-2017        | 525,360  | 1,439   |
| <b>Average</b> |   | <b>1982-2017</b> | <b>1,262,151</b>   | <b>3,455</b>  |

Source: Calculated from NRCS, 2020. *Summary Report: 2017 National Resources Inventory*, Table 1.

The area of cropland (**Figure 15**) in the United States decreased from 420.3 million acres in 1982 to 367.5 million acres in 2017, a reduction of 13 percent. Some of this former cropland (16 million acres in 2017) was temporarily protected under the federal Conservation Reserve Program (CRP)<sup>20</sup> – administered by USDA’s Farm Service Agency (FSA) – the acreage of which rose from 14 million acres in 1987 to 33 million acres in 1997 before falling back down to 16 million acres in 2017. However, CRP lands are considered more “environmentally sensitive” or ecologically marginal lands, often on steeper slopes more vulnerable to erosion,

<sup>20</sup> From the CRP website: “CRP is a land conservation program administered by FSA. In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. Signed into law by President Ronald Reagan in 1985, CRP is one of the largest private-lands conservation programs [sic] in the United States. Thanks to voluntary participation by farmers and landowners, CRP has improved water quality, reduced soil erosion, and increased habitat for endangered and threatened species.” <https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index>

or more generally vulnerable to degradation from plowing, tilling, planting, harvesting, irrigation, fertilization, and other modern industrial farming practices.

Other former croplands were retired from cultivation and converted to pastureland, rangeland, and other rural land categories. However, some cropland was also developed: 11.1 million acres from 1982 to 2017, according to the NRI. “Asphalt is the land’s last crop,” remarked former U.S. Assistant Secretary of Agriculture and conservationist Rupert Cutler back in the 1970s.<sup>21</sup> Once a tract of farmland with its soils and the micro and macro-ecosystems they support are paved over, the probability of that patch of the Earth being restored within the foreseeable future to a functioning ecological habitat or productive agricultural land is miniscule.



**Figure 15. America’s Bountiful Cropland: Productive Wheatfield under the Big Skies of the Great Plains**

The area of U.S. pastureland (**Figure 16**) declined from 131.2 million acres in 1982 to 121.6 million acres in 2017, a decrease of seven percent. The much larger area of non-federal (state and private) rangeland declined slightly over these 35 years, from 418.6 million acres to 403.9 million acres, a decrease of four percent. However, the NRI does not indicate whether the quality of that rangeland may have changed, either positively from implementation of conservation measures, or negatively from agents such as erosion or invasive species like the

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<sup>21</sup> Lester R. Brown and Ed Ayers (eds.), 1998. *World Watch Reader on Global Environmental Issues*. W.W. Norton & Company (New York, London).

inedible creosote bush (*Larrea tridentata*), the spread of which in arid Southwestern rangeland has been facilitated by overgrazing of livestock (**Figure 17**).



**Figure 16. Beef Cattle Grazing on Pastureland in Wisconsin**



**Figure 17. Stand of Creosote Bush on rangeland – while a native species, it is inedible by livestock and is considered invasive because it is an aggressive competitor**

While the NRCS estimates that rates of erosion on the nation's cropland decreased by 35 percent on average between 1982 and 2017, staggering amounts of topsoil are still being lost in spite of improved awareness and soil conservation measures. Every year, more than four and a half tons per acre are washed or blown away from the nation's cultivated and non-cultivated croplands. This totaled 1.7 billion tons in aggregate at the national scale in 2017. Sheet and rill erosion from water accounted for 58 percent of this, while wind erosion was responsible for the other 42 percent.<sup>22</sup>

Most soil scientists concur that it takes at least 100 years for natural processes to form just one inch of soil; the specific rate of soil formation depends on climate, vegetation, slope gradient, and other factors.<sup>23</sup> Overall, scientists estimate that we are losing soils some 10 to 40 times faster than the rate of soil formation or renewal.<sup>24</sup> Obviously, this is unsustainable.

### 1.5.2 Beleaguered Wildlife Habitats and Open Space

The adverse effects of encroaching development extend beyond the zone of impervious surfaces, pavement, and rooftops and penetrate into nearby natural habitats. The fact is that development disturbs adjacent natural habitat even without destroying or altering it directly with bulldozers and construction. Development can cause habitat fragmentation, that is, breaking up large, intact areas of natural habitat into smaller strips, shreds, and fragments.<sup>25</sup>

In such cases, these smaller, disparate, disconnected habitat bits and pieces may be too small to support viable populations of various wild flora and fauna, which are prevented from interacting and breeding due to development barriers like buildings, walls, fences, and streets. Genetic diversity is lost and the risk of inbreeding and reduced survival fitness grows. Housing-induced habitat fragmentation aids the introduction of exotic or invasive species.<sup>26</sup> Due to "edge effects", "patch-size effects," and "isolation effects," fragmentation is accompanied by biodiversity impoverishment and species loss, of both wild plants and wild animals.<sup>27</sup>

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<sup>22</sup> Op cit. Note #17. Page 2-8.

<sup>23</sup> Natural Resources Conservation Service. No date. Soil Formation. Accessed online 6-12-2021 at: [https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wa/soils/?cid=nrcs144p2\\_036333](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wa/soils/?cid=nrcs144p2_036333).

<sup>24</sup> David Pimentel. 2006. Soil Erosion: A Food and Environmental Threat. *Environment, Development and Sustainability*. 8: 119-137. Available online at: <http://saveoursoils.com/userfiles/downloads/1368007451-Soil%20Erosion-David%20Pimentel.pdf>.

<sup>25</sup> The Wildlife Society. Fact Sheet – Wildlife Habitat Fragmentation. Available at: <http://wildlife.org/wp-content/uploads/2014/05/Wildlife-Habitat-Fragmentation.pdf>.

<sup>26</sup> V.C. Radeloff, R.B. Hammer, and S. I. Stewart. 2005. Rural and Suburban Sprawl in the U.S. Midwest from 1940 to 2000 and Its Relation to Forest Fragmentation. *Conservation Biology*. 19(3): 793-805.

<sup>27</sup> Ibid.

It is estimated that about one-third of new houses in the United States are now constructed in undisturbed natural habitats.<sup>28</sup> Roads connecting newly built residential subdivisions and commercial development break up the landscape and create hazards and barriers through wildlife home ranges.<sup>29</sup> As any motorist knows from observing the carnage of roadkill, paved roads and streets are deathtraps for hapless vertebrates: mammals, reptiles, amphibians, and even some birds. An estimated one million animals are killed on American roads every day.<sup>30</sup> Roadkill (**Figure 18**) is now the leading cause of vertebrate mortality in the United States.



**Figure 18. Roadkill is the leading cause of vertebrate mortality in the United States**

Anthropogenic noise from cars, trucks, and motorcycles, railroads, airport takeoffs and landings, compressors, factories, oil and gas exploration and development, and even amplified music from loudspeakers encroaches deeply into natural habitats and adversely affects wildlife through behavioral disruption, acoustic masking, and increased stress response.<sup>31</sup> One recent

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<sup>28</sup> Radeloff, V. C., R. B. Hammer, S. I. Stewart, J. S. Fried, S. S. Holcomb, and J. F. McKeefry. 2005. The wildland-urban interface in the United States. *Ecological Applications* 15:799-805.

<sup>29</sup> Carroll, C., R. F. Noss, P. C. Paquet, and N. H. Schumaker. 2004. Extinction debt of protected areas in developing landscapes. *Conservation Biology* 18:1110-1120.

<sup>30</sup> Marc Bekoff. 2010. Animals and cars: One million animals are killed on our roads every day. *Psychology Today*. Accessed online 7-13-19 at: <https://www.psychologytoday.com/us/blog/animal-emotions/201007/animals-and-cars-one-million-animals-are-killed-our-roads-every-day>.

<sup>31</sup> M. Brittingham. Noise impacts to wildlife: A review of pertinent studies. Department of Ecosystem Science and Management, Penn State University. Available online at: [http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr\\_20028837.pdf](http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_20028837.pdf); Francis, C., C. Ortega, and A. Cruz. 2009. Noise Pollution Changes Avian Communities and Species Interactions.

study found that human noise doubled background sound levels in a majority of our nation's protected natural areas, caused a 10-fold or greater increase in noise in 21 percent of these areas (surpassing noise levels known to interfere with human visitor experience), and significantly impaired habitats of endangered species.<sup>32</sup>

In a 2010 paper in the *Proceedings of the National Academy of Sciences* entitled, "Housing growth in and near United States protected areas limits their conservation value," the authors noted that protected areas are: "crucial for biodiversity conservation because they provide safe havens for species threatened by land-use change and resulting habitat loss." However, the effectiveness of protected areas in the United States is threatened by rural sprawl and housing development in particular. The study's findings show that housing development in close proximity may severely limit the ability of protected areas to serve as a modern "Noah's Ark." The authors found that between 1940 and 2000, 28 million housing units were built within 50 km of protected areas in the United States, and 940,000 homes were even constructed on private inholdings within national forest boundaries.<sup>33</sup>

Further, they found that in the 1990s, housing built within 1 km of protected areas grew at a decadal rate of 20 percent, outpacing the national average of 13 percent. If these trends continue over the long term, another one million housing units would be built within 1 km of protected areas by 2030 (and 17 million housing units within 50 km), greatly reducing their value for wildlife and biodiversity conservation. The habitats protected as national parks, national wildlife refuges, national wilderness areas, and national forests are increasingly isolated spatially in an increasingly fragmented national landscape. In sum, protected areas in America, "are thus threatened similarly to those in developing countries. However, housing growth poses the main threat to protected areas in the United States whereas deforestation is the main threat in developing countries."

Urban expansion, of course, is not merely an American or a North American phenomenon; it is a global one. And globally, urban expansion is also driven by population growth, among other factors, but unsurprisingly, population's role in driving expansion and sprawl varies from continent to continent, region to region, and country to country. For example, population

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*Current Biology* 19:1415-1419; National Park Service. 2018. Effects of Noise on Wildlife. Available at: [https://www.nps.gov/subjects/sound/effects\\_wildlife.htm](https://www.nps.gov/subjects/sound/effects_wildlife.htm).

<sup>32</sup> Rachel T. Buxton, Megan F. McKenna, Daniel Mennitt, Kurt Fristrup, Kevin Crooks, Lisa Angeloni, and George Wittemyer. 2017. Noise pollution is pervasive in U.S. protected areas. *Science*. Vol. 356, Issue 6337, pp. 531-533.

<sup>33</sup> Volker C. Radeloff, Susan I. Stewart, Todd J. Hawbaker, Urs Gimmi, Anna M. Pidgeon, Curtis H. Flather, Roger B. Hammer, and David P. Helmers. 2010. Housing growth in and near United States protected areas limits their conservation value. *Proceedings of the National Academy of Sciences*. 107 (2): 940-945.

growth contributes to urban expansion more in North America than in Europe,<sup>34</sup> which has very low rates of population growth compared to Canada and the United States. Likewise, urban population growth is more closely related to urban expansion in Africa and India (both of which still experience rapid to very rapid population growth), than in China, where population growth is slowing and GDP growth is a greater factor in urban expansion.<sup>35</sup>

Across the world, scholars and planners widely regard population growth as one of the most important factors driving “land take” and urban land expansion, along with income growth (higher GDP per capita), increased transport accessibility, weak or inadequate planning, and subsidies encouraging land consumption and automobile use.<sup>36</sup>

Recognition by scholars that population growth is a major (not the only) driver of urban land expansion and sprawl is sharply at odds with the way the news media and anti-sprawl activists in the United States have tended to portray the causes of sprawl. The news media and anti-sprawl activists have chosen to accept that rapid, unending U.S. population growth on the order of 20 to 30 or more million new residents per decade is a given and a *fait accompli*. They have no intent of questioning or challenging it.

Thus, since they want to convince Americans that something can still be done to halt or slow sprawl substantially in spite of never-ending U.S. population growth, they tend to downplay or minimize population’s importance as a causal factor in sprawl. In their efforts to publicize sprawl to the American public and enlist support for anti-sprawl measures – e.g., “smart growth” policies, higher residential densities, multifamily housing (apartments and condominiums), mixed land uses and zoning, and infill that eliminates existing urban open space (such as golf courses) – they reserve their criticism for “low-density sprawl,” essentially giving a pass to other new development on the urban periphery, as long as it is not low-density, even though it still permanently devours rural land and open space.

## 1.6 Imperiled Habitats and Species

A biome is a floristic region, that is, a large, naturally-occurring community of flora and fauna consisting of a dominant habitat, e.g., forest, grassland, or desert. The United States boasts a number of diverse biomes (**Figure 19**) that reflect its varied climates and geology.

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<sup>34</sup> Karen C. Seto, Michail Fragkias, Burak Güneralp, Michael K. Reilly. A Meta-Analysis of Global Urban Land Expansion. 2011. *PLOS One*. Vol. 6, Issue 8, August.

<sup>35</sup> Ibid.

<sup>36</sup> Alice Colsaet, Yann Laurans, and Harold Levrel. What drives land take and urban land expansion? A systematic review. *Land Use Policy*. 79 (2018): 339-349.

Within the biomes and landscapes threatened by sprawl are found some of our most critical natural habitats. According to the World Wildlife Fund, habitat loss poses the single greatest threat to endangered species around the world. The United States is home to approximately 1,660 species and subspecies of plants and animals formally listed as federally endangered or threatened by the federal government (specifically, by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service). Most of these are seriously harmed by ever-expanding sprawl and ever-encroaching development of one form or another that modifies, degrades, or eliminates the habitats they need to survive.



**Figure 19. Biomes of North America**  
*Source: Virginia Tech Dendrology Factsheets*

A school teachers' guide explains the process that steals habitats and puts species at risk:

As the human population increases, cities, farms, ranches, factories, and shopping malls grow larger and expand into the wilderness....This leaves less habitat for animals and plants. Many of them cannot survive in other places. Their populations drop, and they become in danger of extinction.<sup>37</sup>

Habitat loss imperils wildlife much more than other factors such as pollution, toxics, invasive species, road mortality, overhunting, or poaching.

Endangered species, subspecies, or populations are those rare plants or animals that, if recent trends continue, will likely become extinct within the foreseeable future, barring heroic measures to save them. Threatened species or subspecies may become endangered within the foreseeable future. American habitats support flora and fauna, some of which have become imperiled in the state (in danger of "extirpation" or elimination over part of their overall range) but enjoy healthy populations elsewhere in their range, and others of which are threatened or endangered over large parts of their overall range, throughout their entire U.S. range, or are imperiled on a global scale (that is, they have no healthy populations anywhere).

A 2019 study by scientists with Conservation Science Partners for the Center for American Progress identified urban, agricultural, energy, and transportation "stressors" as the major causes in the loss and fragmentation of natural habitat in the lower 48 states.<sup>38</sup> Population growth exacerbates each of these factors. For example, more people need more farmland to cultivate the crops that become the food that feed those additional numbers. More people require more aggregate energy production to meet more aggregate consumption, hence more land is needed for petroleum exploration and development, access roads, pipelines, coal mines, wind farms, solar arrays, and so forth.

The Conservation Science Partners study concluded that expansion and intensification of land uses in the U.S. resulted in a steady, inexorable loss of natural areas between 2001 and 2017. In these 16 years alone, more than 24 million acres of natural lands and habitats were permanently modified or lost to development, at an average of 1.5 million acres per year. Just how enormous this loss is can be understood by comparing it to the areas of some of America's largest, most beloved national parks, our "crown jewels." The natural habitats lost in just 16 years were equivalent in size to almost nine Grand Canyon National Parks, more than 10 Yellowstone NPs, or 49 Great Smoky Mountains NPs.

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<sup>37</sup> Desert Museum. "Endangered and Threatened Species of the Sonoran Desert Region." Desert Discovery Class Teacher Information ©2000, revised 2008 ASDM.

<sup>38</sup> Conservation Science Partners. 2019. Loss and fragmentation of natural lands in the conterminous U.S. from 2001 to 2017. Available online at: <https://www.csp-inc.org/public/CSP%20Disappearing%20US%20Exec%20Summary%20011819.pdf>.

The urban stressor accounted for 57 percent of all the natural lands lost during the 16-year study period. Thus, urban sprawl devours more natural habitat than all other major causes of habitat loss combined.

Let's look briefly at three habitat types and wild creatures associated with them that long-term population growth, sprawl, and development have drastically impacted over the years. These are not the only imperiled habitats, but they are representative of what is at stake.

**Longleaf Pine Ecosystem** – The once widespread but now severely diminished longleaf pine (*Pinus palustris*) ecosystem (**Figure 20**) once dominated as much as 90 million acres from southern Virginia to Florida and west to eastern Texas. It was once one of the largest ecosystems in North America. Now it occupies less than five percent of its former range. The longleaf pine ecosystem contains possibly the most species-rich communities outside of the tropics, including many highly endangered species such as the Red-cockaded Woodpecker (*Leuconotopicus borealis*) (**Figure 21**). Agriculture (to feed a growing human population), timber harvest, inappropriate fire management (excessive suppression), and urbanization have all taken a toll on the longleaf pine ecosystem.



**Figure 20. Longleaf Pine Ecosystem in the Southeast – More than 95% of it has been lost to Agriculture, Logging, Fire Suppression Practices, and Development**



**Figure 21 – Red-cockaded Woodpecker**

**Tallgrass Prairie Ecosystem** – Prairies once covered 170 million acres in North America. This legendary “sea of grass” reached all the way from the Rocky Mountains to east of the Mississippi River and from Saskatchewan, Canada, in the north to Texas in the south.<sup>39</sup> The tallgrass and shortgrass prairies (**Figure 22**) supported an unfathomable quantity of living tissue or biomass – plants and animals galore – including the iconic, immense, thundering bison herds (some 30-60 million strong), upon which both the Plains Indians and the now-extinct Plains Grizzly and many other living things depended.



**Figure 22. Bison Grazing on the 11,000-acre Tallgrass Prairie National Preserve**

The historic, unplowed tallgrass prairie ecosystem exemplified the ancient, complex web of life and the ecological food pyramid. As an observer gazed upon the undulating waves of grass, at first it would have appeared as if the entire prairie landscape consisted only of grasses, some 40 to 60 species of which did indeed comprise about 80 percent of the extant flora. The other 20 percent of the plants consisted of more than 300 species of forbs or flowers, as well as over

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<sup>39</sup> National Park Service. 2020. Tallgrass Prairie National Preserve, Kansas. A Complex Prairie Ecosystem. Available online at: <https://www.nps.gov/tapr/learn/nature/a-complex-prairie-ecosystem.htm>.

100 species of lichens and liverworts. Many varieties of shrubs and trees flourished in riparian zones in the moist soils along creeks. The rich, productive plant community in turn supported grazing animals in great numbers, such as elk, deer, and antelope, in addition to the bison. Smaller wildlife such as songbirds, hawks, mice, and gophers abounded. Grizzly bears and wolf packs preyed upon the grazers.<sup>40</sup> Plants fed the herbivores, and herbivores fed the carnivores and omnivores, whose nutrients were returned to the soils and recycled by the decomposers, in the great “Circle of Life.”

Euro-American settlers discovered the fertile prairie soils about 150 years ago in their march westward across the continent. Learning that these rich, thick topsoils – chock full of nutrients that had accumulated for millennia – excelled at growing crops and yielding bumper harvests, the settlers plowed the prairie virtually everywhere. Wheat and corn for a rapidly growing, hungry nation were the primary or staple grain crops, but many others were cultivated as well. At present, the most fertile and well-watered part of these once-vast grasslands, the tallgrass prairie, has been reduced to a mere one percent of its original expanse. The once-vast tallgrass prairie is now considered one of the rarest and most imperiled ecosystems on Earth. The largest remaining area of tallgrass prairie never plowed is in the stony, hilly region of Kansas known as the Flint Hills, southeast of Wichita.<sup>41</sup>

**Coastal Sage Scrub Ecosystem** – The aromatic coastal sage scrub ecosystem (**Figure 23**) extends from the San Francisco Bay region southward along California’s coast to the Mexican border and beyond. It is characterized by such plant species as white, black and purple sage, California sagebrush, buckwheat, bush sunflower, laurel sumac, and lemonade berry. It is home to bobcats, ground squirrels, lizards, rattlesnakes, ravens, turkey vultures, and roadrunners, among other creatures. It also provides refuge for the threatened California gnatcatcher (*Polioptila californica californica*).

**Figure 23. Coastal Sage Scrub on the San Diego National Wildlife Refuge**



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<sup>40</sup> Ibid.

<sup>41</sup> Ibid.

The gnatcatcher (**Figure 24**) is a tiny, blue-gray songbird in the old-world warbler and Sylviidae family. It is less than five inches long and weighs just six grams. In spite of its petite size, this feisty bird is known to mob much larger birds that are potential nest predators, such as the California scrub-jay, cactus wren, and roadrunner. Mobbing these larger birds bothers them and drives them away from vulnerable nestlings.



**Figure 24. Adult male California gnatcatcher in its summer breeding plumage**

The California gnatcatcher feeds mainly on small insects and spiders, including beetles, caterpillars, wasps, ants, flies, moths, small grasshoppers, and of course, gnats. It may also eat small berries. One of its adaptations to a semi-arid environment with few perennial surface streams is cleaning its feathers by using water deposited on leaves by rain or coastal fog. The gnatcatcher survives in just six counties in Southern California and a tiny bit of Mexico. It is entirely dependent on coastal sage scrub habitat, an estimated 60-90 percent of which has disappeared under the infamously sprawling suburbs, subdivisions, and freeways of Southern California. Massive post-World War II population growth is the main driver of this sprawl.

## 1.7 Stability of Ecosystems and the Biosphere

In 2017, the population of 49 of America's 50 states (all but Alaska) – 324 million strong – sprawled across an area of 179,807 square miles (115.1 million acres) of developed land, according to the NRCS and its NRI. Much of this developed land was not occupied by residential areas per se, but by the widespread artificial structures, facilities, and infrastructure needed to support modern, high-consumption human settlements. The average land consumption per person (per capita) in 2017 in the United States was 0.356 acre. That is, on average, each American resident accounted for more than a third of an acre of developed land. This area, which is about 15,050 square feet, is much larger (5 or 10 times) than the size (square footage) of a typical American dwelling (private single family home).

For every three residents in America then, on average, slightly more than one acre of land has been converted from open space – both natural habitat and agricultural land – to asphalt and concrete, a wide variety of manmade structures, and artificial landscaping.

As noted in Section 1.4, this 0.356-acre/resident metric does not include relatively unpopulated rural lands – farmlands (cropland, pasture, and rangeland), forests, reservoirs, mines – that furnish crucial raw materials and products used by every resident, namely food, fiber, fuels, water, energy, metals, and minerals. Nor does it include the bioproductive (photosynthesizing) forestlands needed to absorb or assimilate each resident’s carbon dioxide (CO<sub>2</sub>) emissions from fossil fuel combustion to produce electricity and propel our vehicles.

All of these ecologically productive lands not covered with pavement and buildings, but used directly and indirectly by each and every state resident (and all human consumers), contribute to each average American’s ecological footprint (EF). This entails a much larger amount of land than that delineated by the NRI as developed land, approximately 60 times as much in fact, or 20 global acres per American resident, according to the Global Footprint Network (GFN).<sup>42</sup> According to GFN, the biocapacity in the United States is 8.4 global acres per person. Thus, the U.S. has an ecological deficit of 11.6 global acres per person (Figure 10). In essence, America’s human population survives ecologically only by importing carrying capacity from other geological times (e.g., the fossil fuels) and geographic places (e.g., food imports from South America, and forestlands in Canada, Russia, and Brazil sequestering our CO<sub>2</sub> emissions).

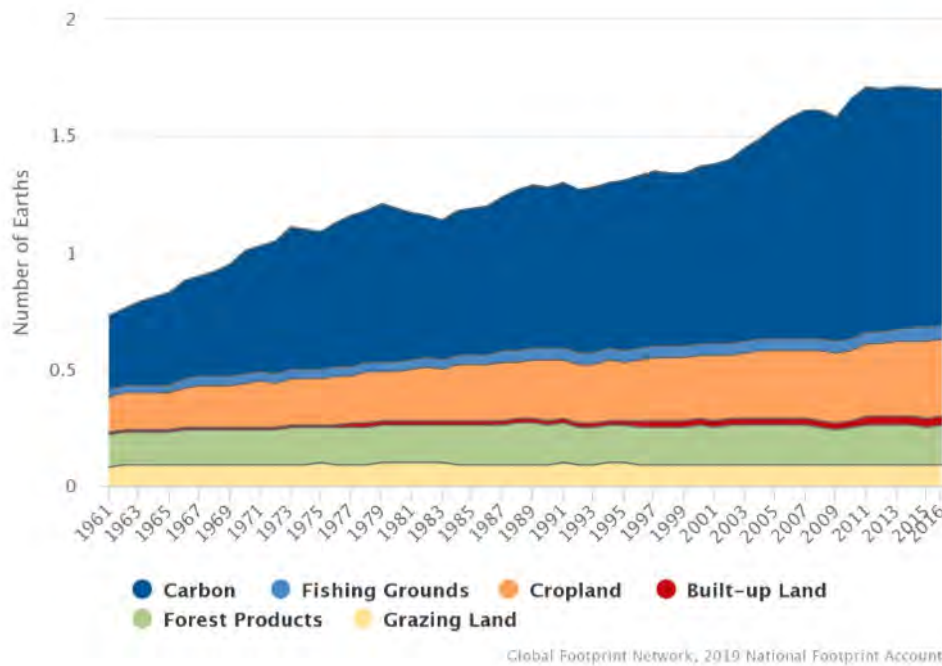
Globally, human civilization as a whole is also already well into overshoot of planetary carrying capacity, according to EF analysis conducted by the GFN. **Figure 25** illustrates that it would take the biocapacity of approximately 1.7 Planet Earths to sustainably provide for the aggregate resource consumption of some 7.8 billion human consumers on the planet.<sup>43</sup>

The elimination of forest, grassland, desert, and wetland habitat from sprawl not only threatens native species, but has serious human health, safety, and economic consequences as well. Wild habitats and ecosystems perform “ecological services.” For example, wetlands (including vegetated riparian areas alongside watercourses) are important filters that clean pollutants out of our water. Wetlands can also moderate the devastating effects of floods by acting as natural buffers and sponges, soaking up and storing floodwaters. According to the Environmental Protection Agency, nearly two-thirds of all fish we Americans consume spend some portion of their lives in wetlands, which often serve as “nurseries” for juveniles. Continuing to pave 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.

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<sup>42</sup> Global Footprint Network. 2015. State of the States Report. Accessed on 1-4-20 at: <https://www.footprintnetwork.org/2015/07/14/states/>

<sup>43</sup> Global Footprint Network. 2019. Data/Methodology. <https://www.footprintnetwork.org/resources/data/>



**Figure 25.**  
**World Ecological**  
**Footprint in 2016**  
**by Land Type**

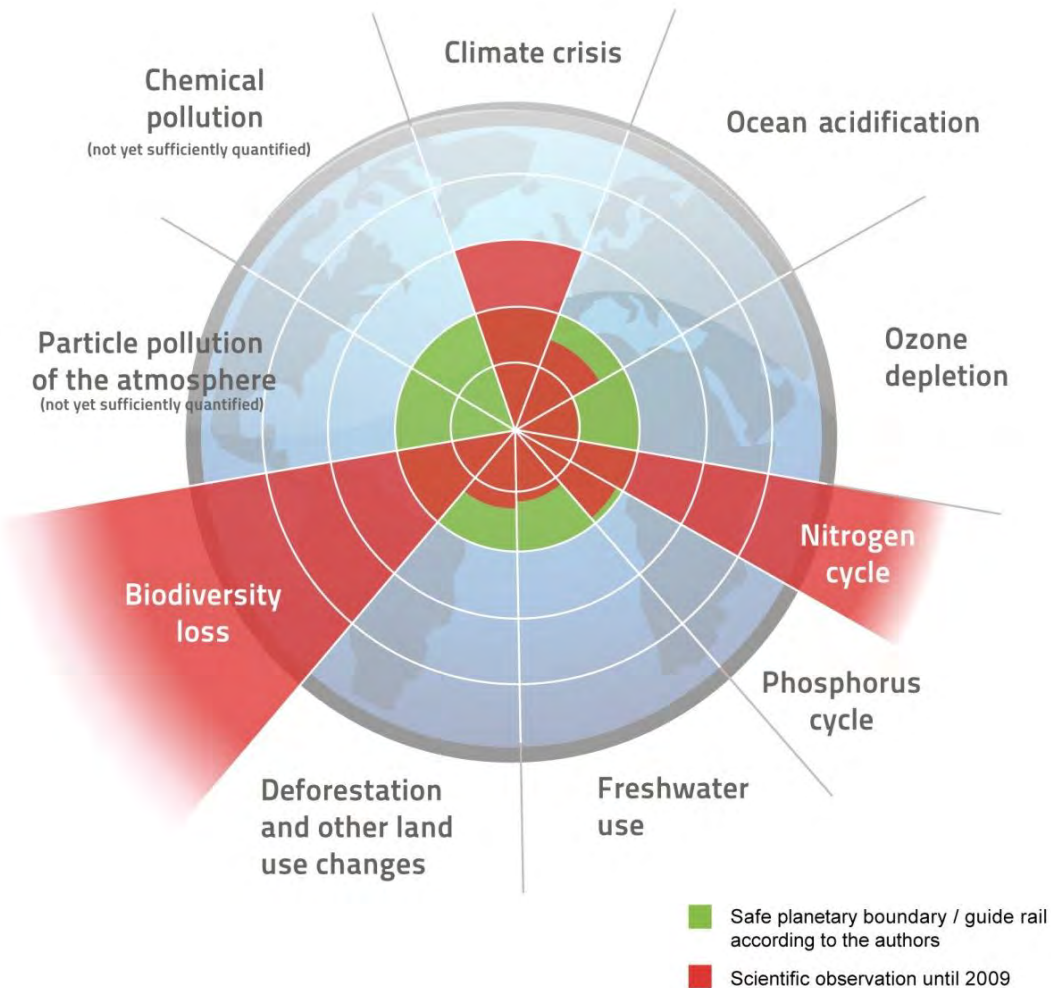
In addition, sprawl in the United States is more than a domestic environmental or quality-of-life issue. It also has global implications. The relentless and accelerating disappearance of natural habitats dominated by communities of wild plants and animals (ecosystems), replaced by biologically impoverished artificial habitats – often “monocultures” – 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 uncontrolled, sudden switch 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.”<sup>44</sup>

Documented declines or collapses in insect, bird, and vertebrate populations in recent decades as a result of the ever-increasing human appropriation of the biosphere’s habitats, spaces, energy flows, and water are a sign that human civilization may be surpassing certain “planetary boundaries.”<sup>45</sup> Ten such boundaries have been identified and quantified, and we are approaching or have already exceeded four of them: climate change, nitrate pollution,

<sup>44</sup> Barnosky, A.D. et al. 2012. “Approaching a state shift in Earth’s biosphere.” *Nature*, Vol. 486, 7 June.

<sup>45</sup> Rockstrom, J., Steffen, W., Noone, K. et al. 2009. Planetary boundaries: Exploring the safe operating space for humanity. *Ecology and Society*, 14(2): 32; Steffen, W., Richardson, K., Rockström, J. et al. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347(6223).

phosphorus pollution, and biodiversity loss (**Figure 26**). A massive extinction of species is now underway and accelerating – the sixth in the history of life on Earth, and the first caused entirely by a single species: humans, aka *Homo sapiens*.<sup>46</sup>



**Figure 26. Planetary Boundaries**

Source: Rockstrom et al. (2009); Footnote #45

Biodiversity scholars have predicted that the world could lose up to half or two-thirds of its species of wild flora and fauna by 2100, if not sooner.<sup>47</sup> In North America, scientists estimate

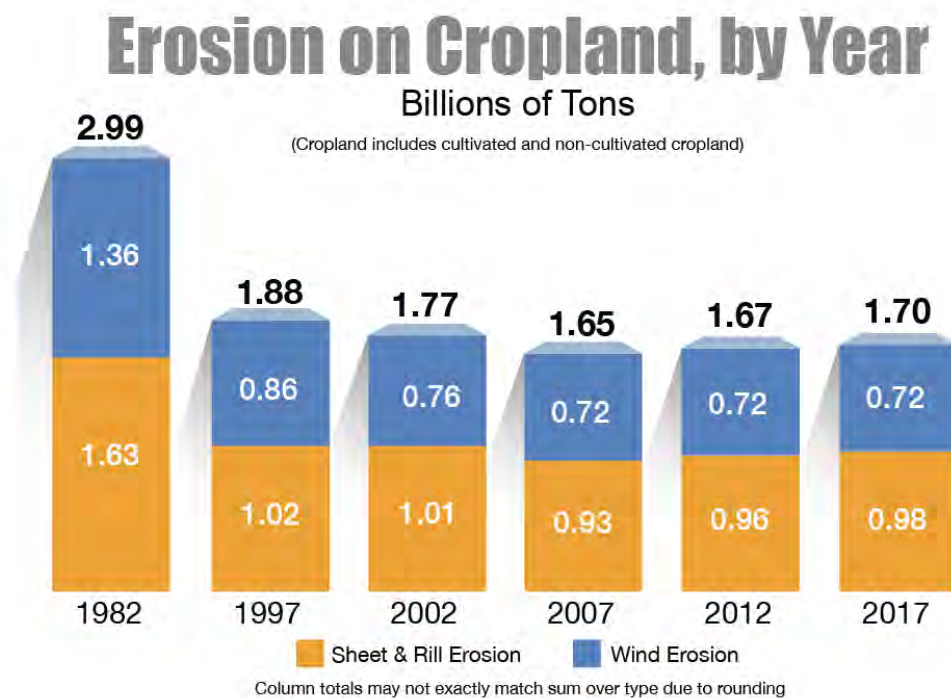
<sup>46</sup> Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019, Media Release: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating'. Retrieved 1-5-2020 at: <https://ipbes.net/news/Media-Release-Global-Assessment>.

<sup>47</sup> Wilson, E.O. 2003. *The Future of Life*. New York: Vintage Books; Raven, P., Chase, J. & Pires, J. 2011. Introduction to special issue on biodiversity. *American Journal of Botany*, 98, 333-335; Chivian, E. & A. Bernstein, eds. 2008. *Sustaining Life: How Human Health Depends on Biodiversity*. Center for Health and the Global Environment. New York: Oxford University Press.

that the number of birds has dwindled by approximately 30 percent since 1970. About three billion fewer birds now grace our skies, lawns, forests, prairies, deserts, and wetlands than just half a century ago. The number of breeding birds in the United States and Canada was estimated at 10 billion in 1970. Today that number has plunged to approximately 7.1 billion.<sup>48</sup>

## 1.8 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 (**Figure 27**), 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 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 the world's ever-increasing populations and more meat- and dairy-intensive diets.

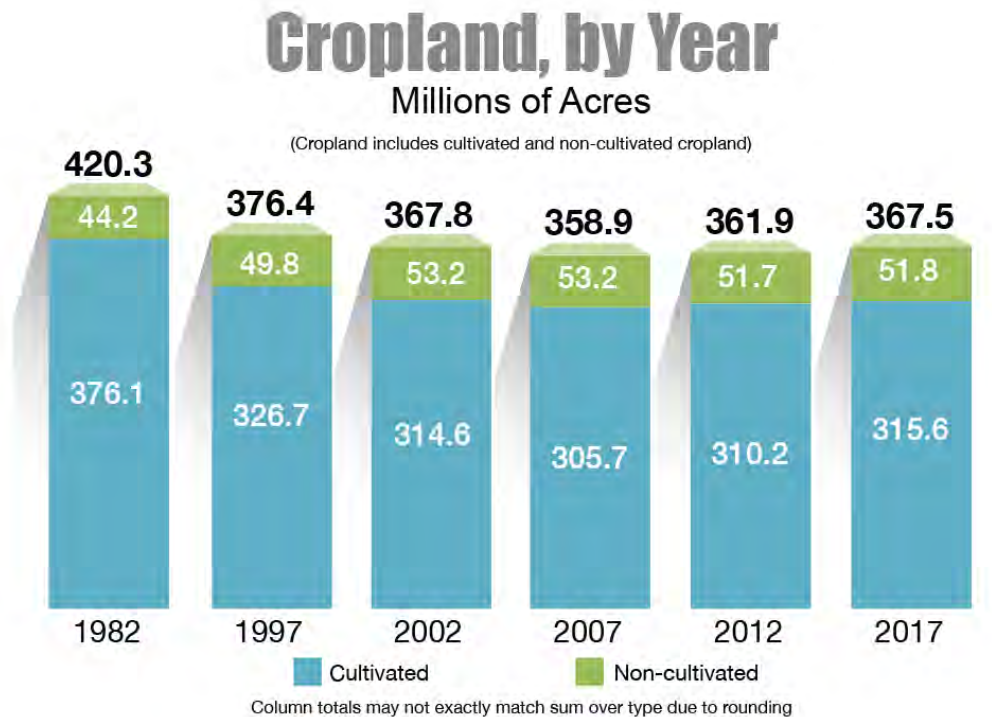


**Figure 27. Annual Erosion on America's Croplands in Billions of Tons**

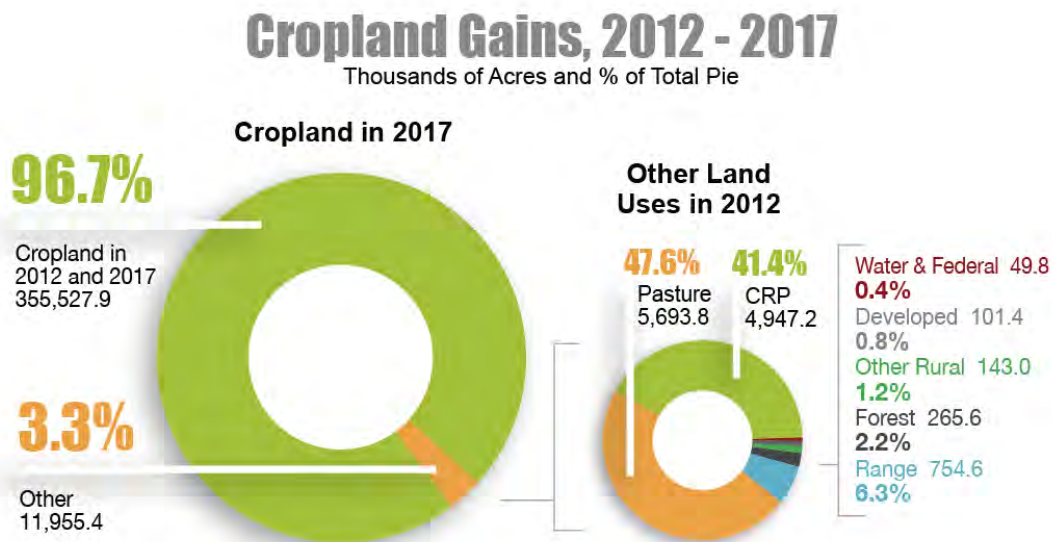
<sup>48</sup> Kenneth V. Rosenberg et al. 2019. Decline of the North American Avifauna. *Science*, 04 Oct 2019, Vol. 366, Issue 6461, pp. 120-124. DOI: 10.1126/science.aaw1313; Carl Zimmer. 2019. Birds Are Vanishing From North America. *New York Times*. Available online at: <https://www.nytimes.com/2019/09/19/science/bird-populations-america-canada.html>.

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. As noted above, the 2017 NRI estimated that the amount of cropland in the United States declined from 420.3 million acres in 1982 to 367.5 million acres in 2017, a decrease of 53 million acres (13 percent) in 35 years (**Figure 28**), an average (mean) of 1.5 million acres per year.

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 or recommended in any case. With the federal ethanol mandate and strong financial incentives over much of the last couple of decades to grow corn in order to produce ethanol as fuel for vehicles, and with higher food and grain prices overall, farmers had tangible motivation to convert CRP land and pastureland into cropland from 2012 to 2017 as shown in **Figure 29**. Approximately 89 percent of the modest 3.3% gain in cropland area from 2012 to 2017 (5.6 million acres) came from pastureland and CRP land.



**Figure 28. Area of Cropland in the United States, 1982-2017**



**Figure 29. Cropland Gains from other Land Uses from 2012 to 2017**

Source: NRCS, 2017. *Summary Report: 2017 National Resources Inventory*. P. 2-4.

Using somewhat earlier estimates, if the same rate of cropland conversion and loss that prevailed from 1982 to 2010 were to continue to the year 2100, the United States would 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, manufactured from ammonia produced from natural gas (Haber-Bosch process), 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 5** 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 Census Bureau projections to 2100. Available cropland would have declined from 1.9 acres per person in 1982 to 0.3 acre per person in 2100, an 84 percent decrease. **Figure 30** graphically depicts this striking loss in the form of a bar chart.

**Table 5. Projected Long-term Decline in Cropland per Person**

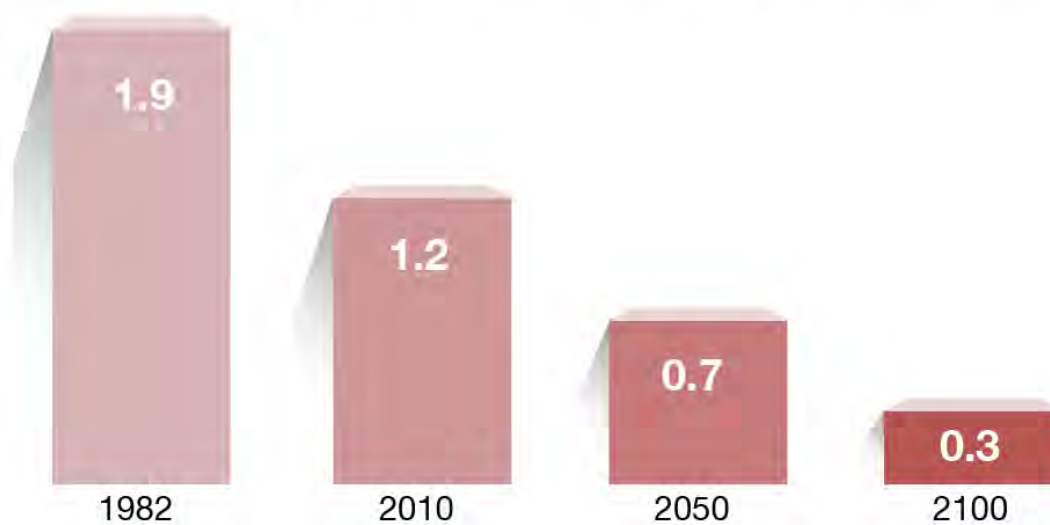
| Year              | Cropland in 48 contiguous states (millions of acres) | U.S. Population in Millions (48 states) | Acres of cropland per capita |
|-------------------|--|---|------------------------------|
| 1982              | 420  | 225                                     | 1.9                          |
| 2010              | 361  | 306                                     | 1.2                          |
| 2050              | 276 <sup>1</sup>                                     | 400 <sup>2</sup>                        | 0.7                          |
| 2100 <sup>3</sup> | 168 <sup>1</sup>                                     | 571 <sup>2</sup>                        | 0.3                          |

<sup>1</sup>Projected using annual rate of cropland loss from 1982-2010 (2.1 million acres)

<sup>2</sup>Most recent projections from the United States Census Bureau

<sup>3</sup>Hollmann et al., 2000.<sup>49</sup>

## Acres of Cropland per capita, 1982-2100

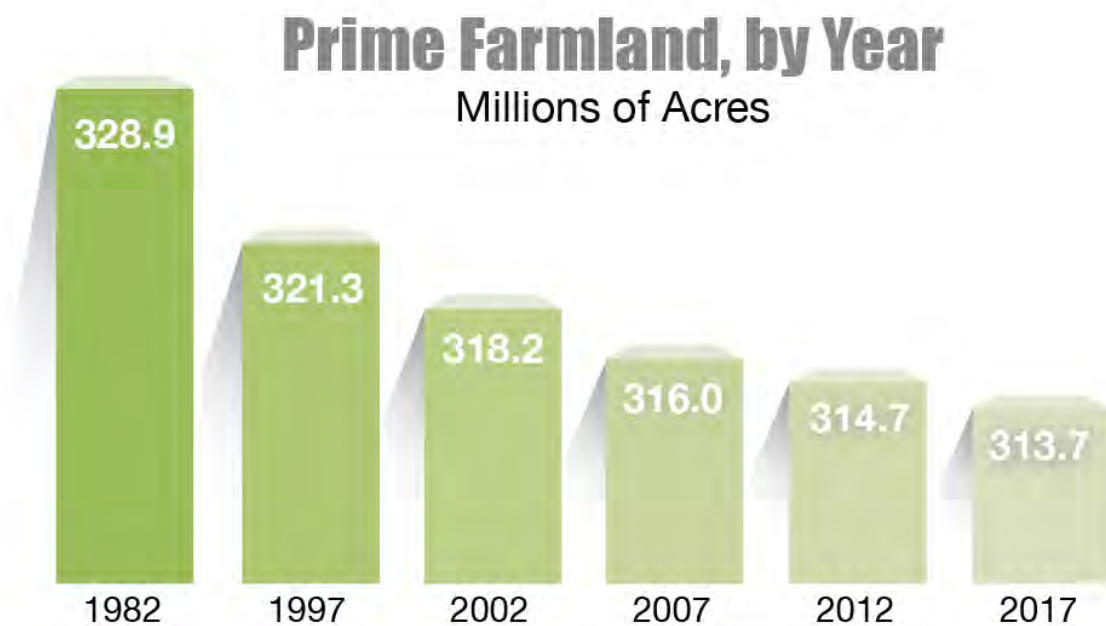
**Figure 30. Projected Long-term Decline in Cropland per Person**

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 29**).

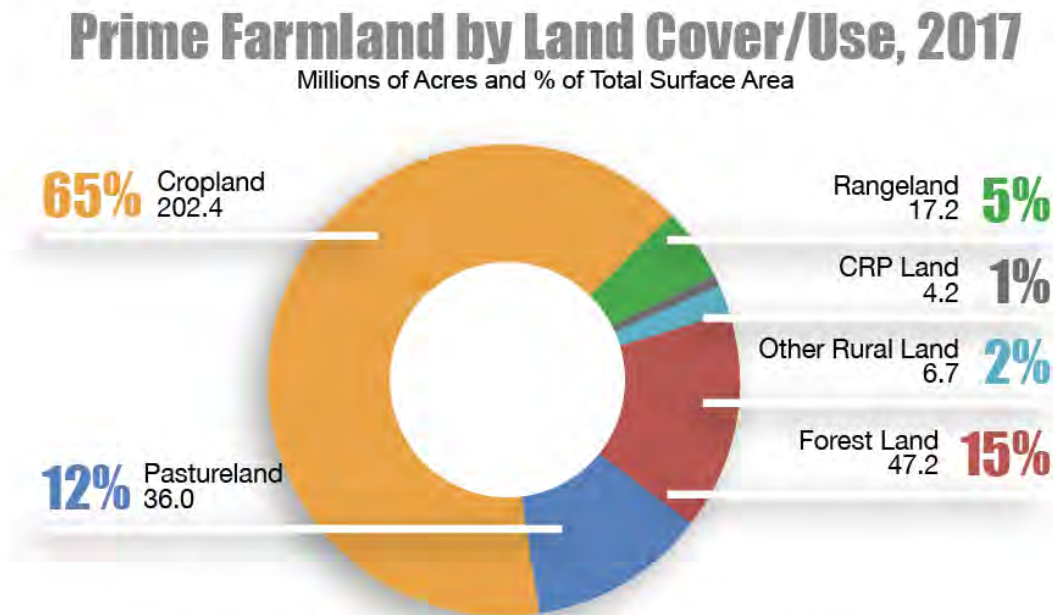
<sup>49</sup> Frederick W. Hollmann, Tammany J. Mulder, and Jeffrey E. Kallan. 2000. "Methodology and Assumptions for the Population Projections of the United States: 1999 to 2100": U.S. Census Bureau, Population Division Working Paper No. 38. Issued January 13, 2000.

As noted above, this actually did occur from 2012 to 2017, during which the area in cropland increased by 5.6 million acres; most of this was pastureland or CRP land pulled back into production because high agricultural commodity prices encouraged farmers to plant it. Again, in an ideal world, erosive or sensitive CRP lands and steeper, less-than-ideal pasturelands should *not* be cultivated and would best be conserved as wildlife habitat and for pasture and grazing; that is why the voluntary Conservation Reserve Program was established in the first place in the 1980s.

Furthermore, the decrease from 1982 to 2017 in the acreage of highest quality soils classified as Prime Farmland, which constitutes only 21 percent (or 313.7 million acres) of the non-Federal rural land base was “only” 15.2 million acres, compared to the 52.8-million-acre decrease in cropland (**Figure 31**). NRCS states that “most of this loss was due to development.” As shown in **Figure 32**, not all designated Prime Farmland is cultivated as cropland; indeed, only 65 percent of it is cropland; the rest is in other non-developed land uses or cover types.



**Figure 31. Decrease in Nation’s Inventory of Prime Farmland, 1982-2017**



### Total Prime Farmland = 314 Million Acres

(Cropland includes cultivated and non-cultivated cropland)

**Figure 32. Prime Farmland by Type in 2017**

*Source:* NRCS, 2020. *Summary Report: 2017 National Resources Inventory. P. 5-2*

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 would 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 20<sup>th</sup> and early 21<sup>st</sup> centuries.

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.<sup>50</sup> 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.”<sup>51</sup> While this may in fact constitute a healthier diet, it would also represent a significant loss of choice for a country that

<sup>50</sup> 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. Satekiewicz, 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.

<sup>51</sup> *Ibid.*

has always prided itself on its abundant agriculture, plentiful consumer options, and comparative freedom from want.

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.<sup>52</sup> 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.<sup>53</sup> As the late 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...”<sup>54</sup>

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 own 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.”<sup>55</sup>

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.<sup>56</sup> Between 2000 and 2013, more than 1,200 deals had taken place, selling more than

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<sup>52</sup> 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.

<sup>53</sup> Tweeten, L. 1998. Food Security and Farmland Preservation. *Drake Journal of Agricultural Law*. 3:237-250.

<sup>54</sup> 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.

<sup>55</sup> 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>.

<sup>56</sup> 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/>.

205 million acres (320,313 square miles) of land to foreign investors; 62 percent of these deals took place in hungry Africa, encompassing 138 million acres (215,625 square miles), an area almost twice the size of Nevada, the 7<sup>th</sup> largest U.S. state.<sup>57</sup> And it isn't just Third World farmland that is being bought by well-heeled foreigners. "'American Soil' Is Increasingly Foreign Owned" was the headline on a 2019 story on NPR's *All Things Considered*.<sup>58</sup> As of 2019, almost 30 million acres of American farmland was owned by foreign investors, a figure which had doubled in the last two decades.

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 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.<sup>59</sup>

Americans are well aware of these food security implications, according to a national poll<sup>60</sup> of 1,500 likely voters in 2020 conducted for this sprawl study (see Appendix G for the entire survey results). The very first question showed that 79 percent overall believed that the destruction of farmland and natural habitat because of urban sprawl in the United States was a "major problem" (44%) or "somewhat of a problem" (35%). In that fourth question of that same poll, when asked if it "is unethical to pave over and build on good cropland," or if "the need to for more housing is a legitimate reason to eliminate cropland," 62% responded that it is unethical to do so, more than three times the percentage (18%) who thought that the need for more housing is a legitimate reason.<sup>61</sup>

Questions two and three from the survey are reproduced here:

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?

62% Very important  
27% Somewhat important  
6% Not very important  
1% Not important at all  
3% Not sure

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<sup>57</sup> Brian Bienkowski. 2013. Corporations Grabbing Land and Water Overseas. *Scientific American*. Available online at: <https://www.scientificamerican.com/article/corporations-grabbing-land-and-water-overseas/>.

<sup>58</sup> National Public Radio. 2019. 'American Soil' Is Increasingly Foreign Owned. Accessed online on 6-30-21 at: <https://www.npr.org/2019/05/27/723501793/american-soil-is-increasingly-foreign-owned>.

<sup>59</sup> American Farmland Trust. 2013. Farmland Protection. Available on the World Wide Web at: <http://www.farmland.org/programs/protection/>.

<sup>60</sup> Op. cit. Footnote #16, Pulse Opinion Research. Appendix G includes the entire poll's results.

<sup>61</sup> Op. cit. Footnote #16.

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?

32% Very important  
45% Somewhat important  
16% Not very important  
4% Not important at all  
3% Not sure

## 1.9 Water Woes

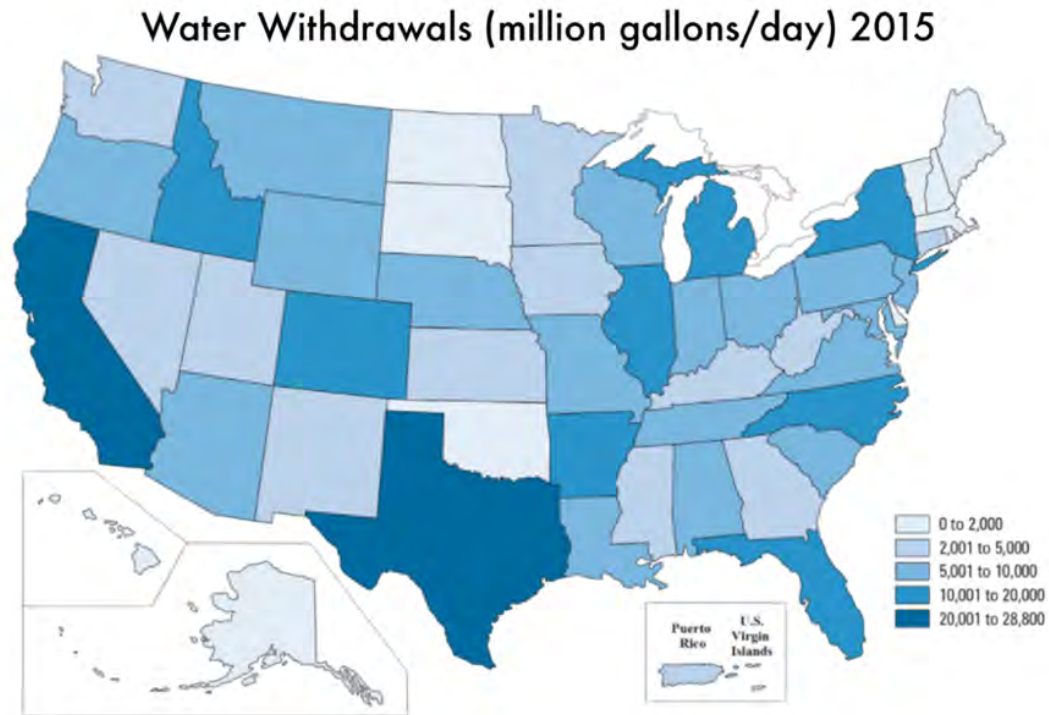
Except for the American Southwest, the United States is comparatively well endowed with water resources. Thus, Americans use prodigious quantities of both surface water (withdrawn from man-made reservoirs, natural lakes and rivers) and groundwater (pumped from subterranean aquifers) to supply agriculture, industry, and municipalities. About 80 percent of our water supply is from surface water sources and the remaining 20 percent from groundwater.<sup>62</sup>

Each and every day on average, the United States withdraws about 400 billion gallons of water for all uses – more than a thousand gallons per person. This volume of water would fill over four million swimming pools or 5,000 Rose Bowls to the rim. **Figure 33** shows total water withdrawals by state in 2015. Notably, the two states with the largest withdrawals are California and Texas, the two most populous states in the country. The three largest categories of water withdrawals are for thermoelectric power (water is used as a coolant in both coal-fired and nuclear electrical generating stations), agricultural irrigation, and public supply, cumulatively accounting for 90 percent of the national total.<sup>63</sup>

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<sup>62</sup> Barber, N. 2009. Summary of estimated water use in the United States in 2005: U.S. Geological Survey Fact Sheet 2009–3098, p. 2; U.S. Geological Survey. No date. How much water is there on Earth? Available online at: [https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science_center_objects=0#qt-science_center_objects)

<sup>63</sup> U.S. Geological Survey. 2014. Total Water Use. Accessed April 11, 2015 at: <http://water.usgs.gov/watuse/wuto.html>.



**Figure 33. Total Water Withdrawals by State in 2015**

Source: U.S. Geological Survey and Dieter et al.<sup>64</sup>

We use water to irrigate our crops, manufacture all manner of products ranging from steel to silicon chips and soft drinks, as well as to water our lawns. We use it to fill our cooking pots, wash away our wastes, and even to cool our thermal (nuclear and coal) power plants. About 80 percent of water used in the U.S. is for agriculture, which is very water-intensive because crops (like all healthy plants) need it for photosynthesis and transpiration.<sup>65</sup> All green plants require enormous amounts of water during the growing season; much of this water is transpired, that is, evaporated back to the atmosphere through pores in leaves called stomata.

Aggregate water use (withdrawals) in the U.S. has actually decreased in recent decades. During this same period, the U.S. population has increased by tens of millions of inhabitants. This illustrates that the relationship between population size and growth and aggregate water consumption is not a simple linear one. Every added increment of population does not necessarily equal an added increment of water consumption. 1 unit of population + 1 unit of

<sup>64</sup> U.S. Geological Survey. No date. Total Water Use. Accessed 7-3-21 at: [https://www.usgs.gov/mission-areas/water-resources/science/total-water-use?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/mission-areas/water-resources/science/total-water-use?qt-science_center_objects=0#qt-science_center_objects); Dieter, C.A., Maupin, M.A., Caldwell, R.R., Harris, M.A., Ivahnenko, T.I., Lovelace, J.K., Barber, N.L., and Linsey, K.S. 2018. Estimated use of water in the United States in 2015: U.S. Geological Survey Circular 1441, 65 p., <https://doi.org/10.3133/cir1441>.

<sup>65</sup> Pimentel, D. et al. 2004. Water Resources, Agriculture, and the Environment. Report 04-1, College of Agriculture and Life Sciences, Cornell University. July.

population  $\neq$  2 units of water use. But nor is it true that there is no correlation at all between aggregate population size and aggregate water withdrawals and consumptive use.

In addition to population size, economic structure and level of activity, water conservation, reuse and efficiency measures all have a bearing in determining total water use in a given area or jurisdiction. For example, Idaho actually ranks third nationally in total water withdrawals, in spite of its comparatively low population (ranked 39<sup>th</sup> of 50 states in population size), because of the high amount of water it uses to irrigate crops fed to human consumers or livestock in other states and other countries. (Some of this water withdrawn for agriculture is “consumptively used”, i.e., incorporated into crops or lost to evapotranspiration, and some of it drains back to watercourses as “return flows”, often carrying salts or contaminants.)

For a period of time, and with strong public commitment and political support, total water use can actually be reduced – or at least held constant – even with a growing U.S. population, as it has been in recent decades. However, the crucial point is that under these special circumstances, if the U.S. population were stable (non-growing), aggregate water consumption could be reduced even more, were the same commitments made to water conservation, reuse and efficiency, allowing still more water to remain where it longs – in natural streams, rivers, and lakes – where it furnishes ecological benefits to habitat, wildlife, and society.

In natural settings, water performs valuable “ecosystem services and functions”. These functions not only include supporting aquatic biota (plants and animals, vertebrates and invertebrates), fisheries and wildlife (such as waterfowl, wading birds, and other water-dependent animals), but also commercial navigation, hydroelectric generation, recreation (e.g., boating, fishing, swimming), and even sight-seeing and tourism.

A prominent example of the latter is Niagara Falls. The Niagara River drains all of the Great Lakes except for Lake Ontario. The water that courses down the Niagara River and over its mighty waterfall is part of the huge St. Lawrence River Basin or watershed, one of the largest in North America. Since 1961, up to 375,000 gallons of water every second have been diverted from the Niagara River upstream of the falls into gigantic conduits or penstocks.<sup>66</sup> The water flows downward by gravity and spins turbines and generators that convert its kinetic energy into clean, low-cost, renewable electric energy (hydroelectric power). The water left to flow down and over the Falls proper is a major tourist attraction (**Figure 34**).

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<sup>66</sup> New York Power Authority. No date. Niagara Power Plant. Retrieved July 3, 2021 at: <https://www.nypa.gov/power/generation/niagara-power-project>.



**Figure 34. Maid of the Mist sightseeing tour boat approaches Horseshoe Falls on the Canadian side of Niagara Falls**

With regard to water, the American Southwest is a special case. It is much drier on average than the rest of the country, and in the 20<sup>th</sup> century, it was made inhabitable by tens of millions (roughly 50 million in 2020) of newcomers only through the invention and widespread availability of air conditioning and the extraordinary exploitation of its scarce surface water and groundwater resources. Snowmelt from the Rocky Mountains pouring into the Colorado River and the Rio Grande, as well as snowmelt in the Sierra Nevada flowing into the Central Valley and the Owens Valley, were effectively “re-plumbed” with a vast network of dams, reservoirs, aqueducts, pumps, and canals (**Figure 35**).



**Figure 35. Los Angeles Aqueduct – it runs south through Owens Valley desert on its way to distant L.A.**

Now the entire system – and the tens of millions who depend on it – is at risk of collapse as a result of a warming, drying climate reducing the amount of water available, and incessant population growth increasing the number of “straws” (or pipes and pumps) sucking on that diminishing pool of water. Growing demands are being placed on a shrinking resource. The Colorado River’s flow, for example, has decreased by an estimated 20 percent over the past century. In June 2021, authorities announced that the water level in the Colorado River’s Lake Mead had dropped to the lowest it has been in 84 years, since 1937, when the reservoir was first filling up. Its volume is now at a mere 36% of its capacity when full, and its water level has dropped 143 feet since 2000, revealing a “bathtub ring” (**Figure 36**).



**Figure 36. Lake Mead on the Colorado River – A “bathtub ring” is clearly visible around its perimeter as its water level drops to unprecedented depths**

The federal government’s Fourth National Climate Assessment indicates that for the rest of this century and beyond, the Southwest will heat up, Rocky Mountains snowpacks will shrivel, and flowing streams will become trickles. The Assessment states unambiguously:

“Increases in temperature would also contribute to aridification (a potentially permanent change to a drier environment) in much of the Southwest, through increased evapotranspiration, lower soil moisture, reduced snow cover....These changes would tend to increase the duration and severity of droughts and generate an overall drier regional climate.”<sup>67</sup>

From 1990 to 2000, the U.S. population grew by approximately 33 million (the highest single decadal growth in American history). From 2010, it grew by another 27 million, and during the decade just concluded (2010-2020), nearly another 23 million residents were added to the U.S. population, for a total of about 83 million new Americans in just the last 30 years. Over the coming eight decades until the end of this century, unless more restrictive immigration policies are enacted, the U.S. population will continue to grow by tens of millions to surpass 400 million by about 2050 or 2060 and approach or surpass 500 million – half a billion – by 2100. At the end of the century, the U.S. population may well still be growing rapidly with no

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<sup>67</sup> Gonzalez et al. 2018. Southwest. Chapter 25 in *Fourth National Climate Assessment*. U.S. Global Change Research Program. Available online at: <https://nca2018.globalchange.gov/chapter/25/>.

peak in sight. These additional tens of millions of residents will also be consumers of resources and emitters of wastes; they will inevitably impose an additional demographic load on environmental resources – including water. And water in its many manifestations, such as wetlands (e.g., swamps, marshes, bogs, fens, riparian areas); estuaries (**Figure 37**), sounds and bays; beaches and coastal areas; groundwater and aquifers; contamination issues; aquatic habitat for wildlife and fisheries (**Figure 38**), and so forth.



**Figure 37. Example of a Small Estuary. Two of the nation’s largest estuaries are Chesapeake Bay on the East Coast and Puget Sound on the West Coast**



**Figure 38. School of Chinook (king) Salmon Smolts. These juveniles, showing their vertical parr marks, migrate from freshwater to the ocean**

Effects on water resources from this population growth, development, and sprawl would vary region by region. The 2014 U.S. National Climate Assessment divides the continental United States into six regions: Northeast, Southeast, Midwest, Great Plains, Southwest, and Northwest.<sup>68</sup> Projected changes in precipitation due to anthropogenic climate change vary

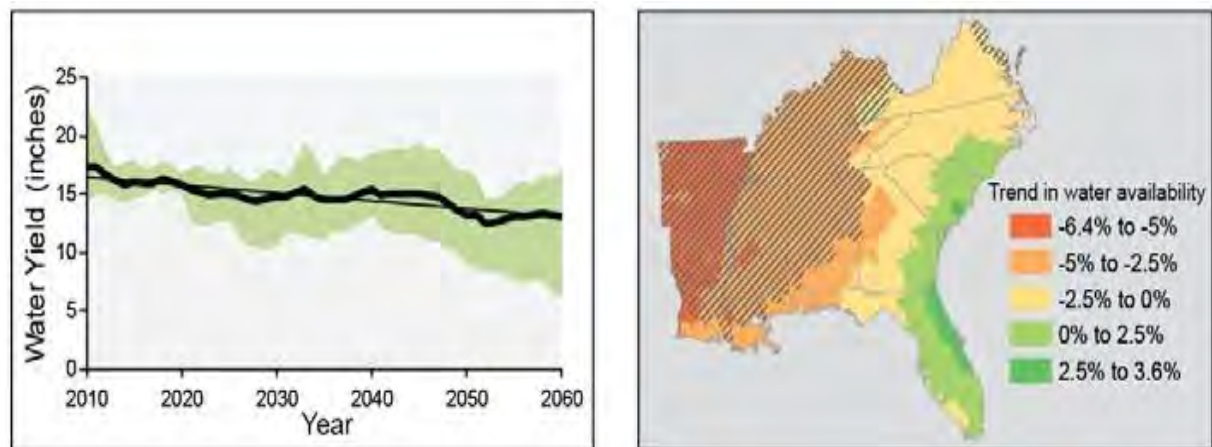
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<sup>68</sup> Melillo, J.M., T.C. Richmond, and G.W. Yohe, Eds. 2014. *Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program, 148 pp.

from region to region. Population projections also vary from region to region: in the contiguous 48 states, the fastest growing regions in recent decades, and also projected to grow the most rapidly in the foreseeable future, are the Southeast, Southwest, and Northwest, although portions of the so-called Great Plains states, especially Texas and Colorado, are also projected to add many millions of residents.

However, if water shortages predicted by current climate change models should come to pass, at least one of these demographic projections in particular may not be realistic – that for the Southwest. The 2014 National Climate Assessment states: “Snowpack and streamflow amounts are projected to decline in parts of the Southwest, decreasing surface water supply reliability for cities, agriculture, and ecosystems.”<sup>69</sup>

The Southeast Region is also anticipated to experience water supply problems. One of the three key messages for the region in the 2014 National Climate Assessment is: “Decreased water availability, exacerbated by population growth and land-use change, will continue to increase competition for water and affect the region’s economy and unique ecosystems.” While changes in projected precipitation for this region are highly uncertain, the reasonable expectation is that there will be reduced water availability due to the increased evaporative losses resulting from rising temperatures alone (**Figure 39**).<sup>70</sup>



**Figure 39. Downward Trend in Water Availability in the Southeast Region**

<sup>69</sup> Garfin, G., G. Franco, H. Blanco, A. Comrie, P. Gonzalez, T. Piechota, R. Smyth, and R. Waskom. 2014. Ch. 20: Southwest. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J. Melillo, T. Richmond, and G. Yohe, Eds., U.S. Global Change Research Program, 462-486. doi:10.7930/J08G8HMN.

<sup>70</sup> Carter, L., J. Jones, L. Berry, V. Burkett, J. Murley, J. Obeysekera, P. Schramm, and D. Wear. 2014. Ch. 17: Southeast and the Caribbean. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J. Melillo, T. Richmond, and G. Yohe, Eds., U.S. Global Change Research Program, 396-417. doi:10.7930/J0NP22CB.

A 2016 Environmental Impact Statement (EIS) prepared by Progressives for Immigration Reform, concluded this about the impacts of business-as-usual U.S. population growth trends on water resources:

**“Overall, the net effect of the No Action Alternative on water demands and withdrawals from natural systems would be adverse, significant, and long-term.** The degree of severity of this effect would vary from region to region, with impacts in the Southwest and Southeast being the most severe and other regions less so. While water-saving practices and technologies could to an appreciable extent ameliorate the adverse effects on water resources of adding 215 million more Americans [by the year 2100], they would not entirely eliminate them. If the population were not growing so robustly, then savings from widespread implementation of water conservation and efficiency would allow more water to be retained in – rather than withdrawn from – aquatic ecosystems. This in turn would benefit the flora and fauna of these natural systems as well as restoring and enhancing the diminished levels of ecosystem services they currently furnish to society.”<sup>71</sup>

A still more recent study investigating the likelihood of water shortages over the rest of the 21<sup>st</sup> century in 204 watersheds in the contiguous United States concluded that:

“Population growth and climate change will combine to pose substantial challenges for water management in the United States. Projections of water supply and demand over the 21<sup>st</sup> century show that in the absence of further adaptation efforts, serious water shortages are likely in some regions.”<sup>72</sup>

The study noted that ongoing improvements in water use efficiency are likely to continue, but that these will not be enough to avoid future shortages. It will be necessary to divert potentially substantial amounts of water away agricultural irrigation,<sup>73</sup> compromising the productivity of our irrigated farmlands (i.e., reducing yields or crop output per acre).

## **1.10 Rejuvenating the Human Spirit: 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 swamp or mangrove-fringed estuary next to a city – gives human beings a sense of perspective, continuity in a changing world, spiritual renewal, well-

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<sup>71</sup> Progressives for Immigration Reform. 2016. Final Environmental Impact Statement on U.S. Immigration Policy. P. 3-147.

<sup>72</sup> Thomas C. Brown, Vinod Mahat, Jorge A. Ramirez. 2019. Adaptation to Future Water Shortages in the United States Caused by Population Growth and Climate Change. *Earth's Future*. 28 February. Available online at: <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2018EF001091>.

<sup>73</sup> Ibid.

being, and a feeling of harmony with the world around us. The presence of open space within and adjacent to our urban areas (**Figure 40**) – and the assurance that this open space will outlast us – serves to counterbalance the stress and strain of modern life.

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.<sup>74</sup> 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 compared to 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.<sup>75</sup> In studies of hospital patients, recovery was faster, there were fewer negative evaluations in patient reports, and there was less use of anesthetic medication among post-surgery patients with views of exterior greenery than among control group patients with views of buildings.<sup>76</sup>



**Figure 40. Central Park Has Been Called a “Green Oasis” in New York City**

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<sup>74</sup> 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>.

<sup>75</sup> Ulrich, R. 1979. Visual landscapes and psychological well-being. *Landscape Research*, 4(1): 17-23.

<sup>76</sup> 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.

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.<sup>77</sup> 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."<sup>78</sup>

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."<sup>79</sup>

While there are many anecdotal reports linking 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.<sup>80</sup> Few studies track long-term longitudinal effects on changed attitudes and behavior. While it is difficult to characterize and quantify the long-term, intangible 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."<sup>81</sup>

Natural settings are unparalleled in their ability to furnish solitude, privacy, and tranquility. They also have "existence value," that is, there is value to knowing that they are simply *there*

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<sup>77</sup> Cimprich, B. E. 1990. Attentional fatigue and restoration in individuals with cancer. Unpublished Doctoral Dissertation, University of Michigan.

<sup>78</sup> 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.

<sup>79</sup> Kaplan, R., & Kaplan, S. (1989). *The Experience of nature: A Psychological perspective*. New York: Cambridge University Press.

<sup>80</sup> Op. cit. Footnote #48, Rubenstein.

<sup>81</sup> John Muir. *The Mountains of California*. First published in 1894.

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.

The May 2020 national survey<sup>82</sup> mentioned above of 1,500 likely American voters found that most of them recognize the value of nature and open space for their emotional well-being. Questions 7 and 8 on that survey addressed this connection directly:

7\* Do you feel an emotional or spiritual uplift from time spent in natural areas like woodlands, wetlands and grasslands?

73% Yes

16% No

11% Not sure

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

45% Very important

40% Somewhat important

10% Not very important

2% Not important at all

3% Not sure

Almost three-quarters said they feel an “emotional or spiritual uplift” from time spent in natural areas, while 85 percent indicated that it is important to be able to reach natural areas “fairly quickly” from their homes. The lead author of this study (Kolankiewicz) is an avid hiker and has frequently been surprised at the number of Americans who share his pastime or passion, such as the hundreds of hikers he encountered on one hot weekday evening in an ascent of Piestewa Peak (**Figure 41**) in Phoenix, AZ and hundreds more on a typical autumn Saturday afternoon on the edge of Boulder, CO embarking on a hike to the Flatirons (**Figure 42**), a prominent landmark on the Colorado Rocky Mountain Front Range.

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<sup>82</sup> Op. cit. Footnote #16. Pulse Opinion Research, 2020; Appendix G to this report.



**Figure 41. Hikers on popular Piestewa Peak in the Phoenix-Mesa Urbanized Area**



**Figure 42. View of the Flatirons in the Colorado Front Range near Boulder**

## 1.11 Americans Love Their Open Space

While not garnering the media attention it once did, the topic of urban sprawl remains a major concern to many American citizens. 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.<sup>83</sup> The 46 measures passed nationally in 2012 provided 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, the North Florida Land Trust, the New Mexico Land Trust, and the Western Pennsylvania Conservancy continue to garner substantial public support. In the November 2016 election alone, 25 land conservation ballot measures were voted on in 10 different states.<sup>84</sup>

In 2018, the Trust for Public Land helped communities draft and campaign for 18 ballot measures on Election Day 2018. Voters approved all but one of the 18. In total, of some 61 ballot measures voted on nationwide in 2018, 52 passed, including two in Arizona. By a margin of 56 to 44 percent, Tucson voters approved \$24 million in bonds for parks and recreation (parks, trails, recreation, greenways), while voters in Mesa approved \$5.9 million for parks and recreation by the same margin.<sup>85</sup> Nationwide, on Election Day in 2019, voters approved 33 of 41 ballot measures, raising over \$900 million in funding for conservation. Overall, between 1988 and 2019, American voters passed 2,096 of 2,758 the open space ballot measures (76 percent) they voted on.<sup>86</sup>

While these were not anti-sprawl measures per se, they do indicate that the American public cares deeply about preserving open space, and is willing to “put its money where its mouth is.”

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<sup>83</sup> 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>.

<sup>84</sup> Trust for Public Land. 2016 conservation ballot measures. Accessed March 2017 at: <https://www.tpl.org/2016-conservation-ballot-measures#sm.0001r394ttayecqpw771offt5wflx>.

<sup>85</sup> Trust for Public Land. TPL LandVote Database. Retrieved online 1-13-2020 at: <https://tpl.quickbase.com/db/bbqna2qct?a=dbpage&pageID=8>.

<sup>86</sup> Ibid.

Urban sprawl 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.<sup>87</sup>

In short, Americans still value our rural lands and natural habitats; oppose heavy traffic, gridlock, and longer commute times to work and to daily, weekly, and monthly open-space destinations; and dislike increased environmental degradation, greater economic costs, and higher taxes; all of which are part of the price tag of sprawling urban development.

As noted above, the 2020 polling<sup>88</sup> found that sizeable majorities of Americans feel strongly about the need to protect farmland and natural habitats for themselves, for their fellow Americans, for posterity, and for the nation's wildlife. Large majorities also indicated it was important to have ready access to natural areas and open space and that they felt spiritually and emotionally rejuvenated by the time they spent in natural areas.



**Figure 43. Stunning Sunset Over Monument Valley on the Navajo Nation (Northeastern Arizona)**

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<sup>87</sup> 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](http://www.fodorandassociates.com/Reports/Myth_of_Smart_Growth.pdf).

<sup>88</sup> Op. cit. Footnote #16, Pulse Opinion Research. Also see Appendix G.

## 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 in National Resources Inventories (NRIs) developed every five years or so for almost 40 years (since 1982). This study, unlike others we have prepared over the past 20 years, uses only the NRI data (in conjunction with Census population estimates for each county in the 49 states covered).

The NRCS uses remote sensing, survey, and statistical techniques to derive NRI's 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.

## 2.2 Our Main Data Source – the National Resources Inventory

County-by-county Developed Land data from the 1982-2017 National Resources Inventories served as the main data source for our current study of sprawl in the United States. While the Census data pertain to a discrete list of designated cities, the NRI data furnish a portrait that also includes development in places in counties around the country that are outside of the boundaries of the Census Bureau’s UAs. Therefore, we were able to assess and include traditional sprawl and development within American cities as well as the more diffuse development and sprawl dispersed across the entire state, as evidenced in the NRI data. The NRI refers to these areas of more dispersed development as “Small Built-up Areas.” In 2015, Small Built-up Areas comprised 7.4 million acres or about six percent of the total of 116.3 million acres of Developed Land in the contiguous United States (**Figure 44**).



**Figure 44. Rural Scene in Kentucky**

This study quantifies the amount of sprawl in the United States (except for Alaska) over the most recent periods for which the most comprehensive government data are available: 1982-2017. Available NRI Developed Land estimates span an uninterrupted 35-year period from 1982-2012 in seven 5-year intervals (1982-1987, 1987-1992, 1992-1997, 1997-2002, 2002-2007, 2007-2012, 2012-2017). These estimates quantify how much rural land was converted into developed or built-up land over these discrete time intervals, as well as over the 35-year time period in its entirety.

The 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.<sup>89</sup>

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.<sup>90</sup>

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.<sup>91</sup>

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<sup>89</sup> 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](http://www.nrcs.usda.gov/technical/NRI/2007/2007_NRI_Summary.pdf).

<sup>90</sup> Ibid.

<sup>91</sup> Ibid.

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.<sup>92</sup>

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.<sup>93</sup>

A number of quality control and quality assurance (QC/QA) processes are conducted by NRCS and contract staff as well as by the Statistical Unit and NRCS resource inventory specialists. Many of these QC/QA processes are embedded within the survey software developed by NRCS and the Statistical Unit. The QC/QA 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.<sup>94</sup>

NRI’s broadest classification divides all U.S. territory into three categories: federal land, water areas, and non-federal land. Non-federal land is divided 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

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<sup>92</sup> Ibid.

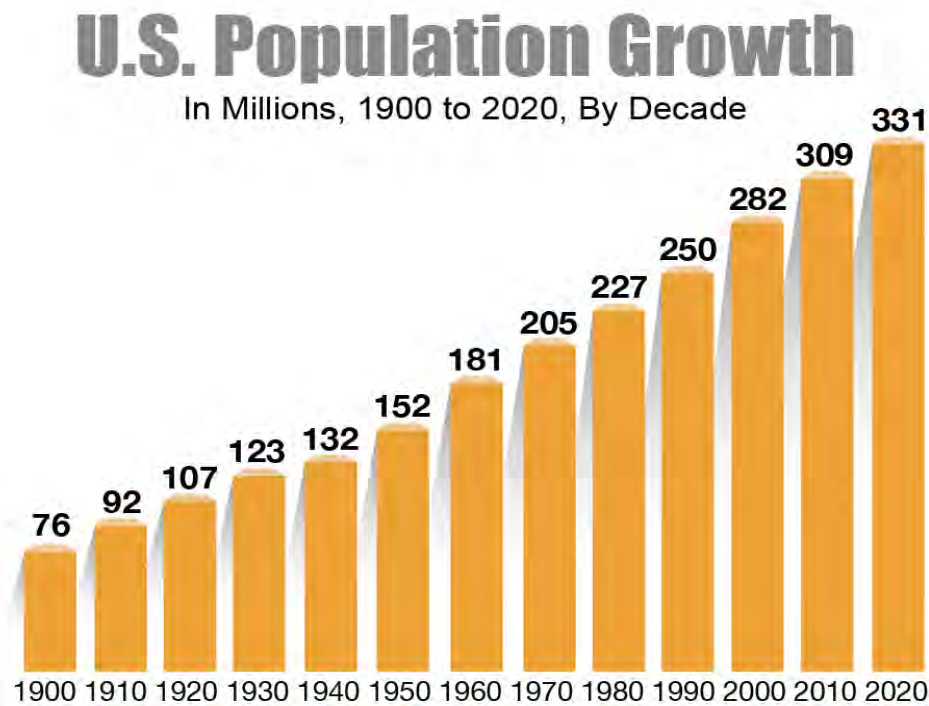
<sup>93</sup> Ibid.

<sup>94</sup> Ibid.

(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

How and whether a country or state's population grows is based on personal behavior – births and in-migration – and on local and national governmental actions and policies. Looking more closely, the net increase (or 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. **Figure 45** shows population growth in the United States from 1900 to 2020. Over this 120-year time period, the U.S. population more than quadrupled. With little evidence that the United States is anywhere close to approaching population stabilization, in spite of recent protestations by pundits and politicians that growth is stagnating; a population that grew by nearly 23 million from 2010 to 2020 is not “stagnating”!



**Figure 45. U.S. Population Growth from 1900 to 2020, by Decade**

*Data source: U.S. Census Bureau*

For most of U.S. history, Americans' large family size drove the majority of population growth. But with a reduction in American family size and a quadrupling of annual immigration since the 1950s and 1960s, net foreign migration has become the driver of most U.S. population expansion. **Table 6** shows the data in **Figure 45** in tabular format.

**Table 6. U.S. Population Growth, 1900 to 2020, By Decade**

| Year | U.S. Population Size (millions) | Gain from Previous Decade |
|------|---------------------------------|---------------------------|
| 1900 | 76                              |                           |
| 1910 | 92                              | 16                        |
| 1920 | 107                             | 15                        |
| 1930 | 123                             | 16                        |
| 1940 | 132                             | 9                         |
| 1950 | 152                             | 20                        |
| 1960 | 181                             | 29                        |
| 1970 | 205                             | 24                        |
| 1980 | 227                             | 22                        |
| 1990 | 250                             | 23                        |
| 2000 | 282                             | 32                        |
| 2010 | 309                             | 27                        |
| 2020 | 331                             | 22                        |

Nowadays, rapid growth in a state, county, or urban area's population is much more likely to be the result of enticing residents to relocate from elsewhere. Local and state governments can and do create many explicit incentives or subsidies that encourage people and businesses to move into a particular urban area. These include aggressive campaigns to persuade industries and corporations to move their factories, offices, headquarters, and jobs from another location, public subsidies for the infrastructure that supports businesses, tax breaks, expansion of water service and sewage lines into new areas, new housing developments and new residents, and general public relations that increase the attractiveness and "business friendliness" of a city to outsiders and the business community. A city can bask in and boast about its good scenery or weather. It can also attract new residents just by maintaining amenities, good schools, low crime rates, pleasant parks, and a high quality of life and cultural opportunities, especially if the nation's population is growing significantly, as continues to be the case today.

During the 35-year period of this sprawl study, from 1982 to 2017, every state but West Virginia grew in population, but some states grew much faster than others. On average, the country's population as a whole grew by 2.66 million annually during these 35 years. **Table 7** shows population data for the 49 states in this study, specifically their Census Bureau-estimated populations in 1982, 2002, and 2017. **Table 8** shows change (growth or decline) in state populations from 1982 to 2017 ranked by most to least (in absolute numbers). **Table 9**

ranks the states by percentage change in population from 1982 to 2017. County-level data for the 49 states are included in the appendices.

**Table 7. Population Size and Growth in 49 States, 1982-2017 and 2002-2017**

| State       | 1982 Population | 2002 Population | 2017 Population | Pop Change – 1982 to 2017 | Pop Change – 2002 to 2017 |
|-------------|-----------------|-----------------|-----------------|---------------------------|---------------------------|
| Alabama     | 3,925,263       | 4,480,089       | 4,874,486       | 949,223                   | 394,397                   |
| Arizona     | 2,889,860       | 5,396,255       | 7,044,008       | 4,154,148                 | 1,647,753                 |
| Arkansas    | 2,294,254       | 2,705,927       | 3,001,345       | 707,091                   | 295,418                   |
| California  | 24,820,007      | 34,871,843      | 39,358,497      | 14,538,490                | 4,486,654                 |
| Colorado    | 3,061,562       | 4,490,406       | 5,611,885       | 2,550,323                 | 1,121,479                 |
| Connecticut | 3,139,014       | 3,458,749       | 3,573,297       | 434,283                   | 114,548                   |
| Delaware    | 599,148         | 806,169         | 956,823         | 357,675                   | 150,654                   |
| Florida     | 10,471,405      | 16,689,370      | 20,963,613      | 10,492,208                | 4,274,243                 |
| Georgia     | 5,649,788       | 8,508,256       | 10,410,330      | 4,760,542                 | 1,902,074                 |
| Hawaii      | 993,780         | 1,239,613       | 1,424,393       | 430,613                   | 184,780                   |
| Idaho       | 973,719         | 1,340,372       | 1,717,715       | 743,996                   | 377,343                   |
| Illinois    | 11,423,413      | 12,525,556      | 12,778,828      | 1,355,415                 | 253,272                   |
| Indiana     | 5,467,918       | 6,155,967       | 6,658,078       | 1,190,160                 | 502,111                   |
| Iowa        | 2,888,190       | 2,934,234       | 3,141,550       | 253,360                   | 207,316                   |
| Kansas      | 2,401,207       | 2,713,535       | 2,908,718       | 507,511                   | 195,183                   |
| Kentucky    | 3,683,449       | 4,089,875       | 4,452,268       | 768,819                   | 362,393                   |
| Louisiana   | 4,352,609       | 4,497,267       | 4,670,560       | 317,951                   | 173,293                   |

| <b>State</b>   | <b>1982<br/>Population</b> | <b>2002<br/>Population</b> | <b>2017<br/>Population</b> | <b>Pop Change –<br/>1982 to 2017</b> | <b>Pop Change –<br/>2002 to 2017</b> |
|----------------|----------------------------|----------------------------|----------------------------|--------------------------------------|--------------------------------------|
| Maine          | 1,136,683                  | 1,295,960                  | 1,334,612                  | 197,929                              | 38,652                               |
| Maryland       | 4,282,923                  | 5,440,389                  | 6,023,868                  | 1,740,945                            | 583,479                              |
| Massachusetts  | 5,771,222                  | 6,417,206                  | 6,859,789                  | 1,088,567                            | 442,583                              |
| Michigan       | 9,115,196                  | 10,015,710                 | 9,973,114                  | 857,918                              | (42,596)                             |
| Minnesota      | 4,131,450                  | 5,018,935                  | 5,566,230                  | 1,434,780                            | 547,295                              |
| Mississippi    | 2,556,776                  | 2,858,681                  | 2,988,510                  | 431,734                              | 129,829                              |
| Missouri       | 4,929,456                  | 5,674,825                  | 6,106,670                  | 1,177,214                            | 431,845                              |
| Montana        | 803,984                    | 911,667                    | 1,052,482                  | 248,498                              | 140,815                              |
| Nebraska       | 1,581,776                  | 1,728,292                  | 1,915,947                  | 334,171                              | 187,655                              |
| Nevada         | 881,538                    | 2,173,791                  | 2,969,905                  | 2,088,367                            | 796,114                              |
| New Hampshire  | 947,720                    | 1,269,089                  | 1,348,787                  | 401,067                              | 79,698                               |
| New Jersey     | 7,430,970                  | 8,552,643                  | 8,885,525                  | 1,454,555                            | 332,882                              |
| New Mexico     | 1,363,822                  | 1,855,309                  | 2,091,784                  | 727,962                              | 236,475                              |
| New York       | 17,589,737                 | 19,137,800                 | 19,589,572                 | 1,999,835                            | 451,772                              |
| North Carolina | 6,019,108                  | 8,326,201                  | 10,268,233                 | 4,249,125                            | 1,942,032                            |
| North Dakota   | 668,972                    | 638,168                    | 754,942                    | 85,970                               | 116,774                              |
| Ohio           | 10,757,085                 | 11,407,889                 | 11,659,650                 | 902,565                              | 251,761                              |
| Oklahoma       | 3,206,129                  | 3,489,080                  | 3,931,316                  | 725,187                              | 442,236                              |
| Oregon         | 2,664,919                  | 3,513,424                  | 4,143,625                  | 1,478,706                            | 630,201                              |

| State              | 1982<br>Population | 2002<br>Population | 2017<br>Population | Pop Change –<br>1982 to 2017 | Pop Change –<br>2002 to 2017 |
|--------------------|--------------------|--------------------|--------------------|------------------------------|------------------------------|
| Pennsylvania       | 11,845,146         | 12,331,031         | 12,787,641         | 942,495                      | 456,610                      |
| Rhode Island       | 954,170            | 1,065,995          | 1,055,673          | 101,503                      | (10,322)                     |
| South Carolina     | 3,207,611          | 4,107,795          | 5,021,268          | 1,813,657                    | 913,473                      |
| South Dakota       | 690,597            | 760,020            | 872,868            | 182,271                      | 112,848                      |
| Tennessee          | 4,646,043          | 5,795,918          | 6,708,799          | 2,062,756                    | 912,881                      |
| Texas              | 15,331,408         | 21,690,325         | 28,295,273         | 12,963,865                   | 6,604,948                    |
| Utah               | 1,558,314          | 2,324,815          | 3,101,042          | 1,542,728                    | 776,227                      |
| Vermont            | 519,108            | 615,442            | 624,344            | 105,236                      | 8,902                        |
| Virginia           | 5,492,785          | 7,286,873          | 8,463,587          | 2,970,802                    | 1,176,714                    |
| Washington         | 4,276,551          | 6,052,349          | 7,423,362          | 3,146,811                    | 1,371,013                    |
| West Virginia      | 1,949,605          | 1,805,414          | 1,817,004          | (132,601)                    | 11,590                       |
| Wisconsin          | 4,728,862          | 5,445,162          | 5,790,186          | 1,061,324                    | 345,024                      |
| Wyoming            | 506,400            | 500,017            | 578,931            | 72,531                       | 78,914                       |
| <b>Entire USA*</b> | <b>230,580,652</b> | <b>286,409,698</b> | <b>323,550,933</b> | <b>92,970,281</b>            | <b>37,141,235</b>            |

Source: U.S. Census Bureau population estimates

\*Note: Includes all states except Alaska; does not include territories

**Table 8. Population Change in 49 States, 1982-2017, Ranked By Numerical Growth**

| State          | 1982 Population | 2017 Population | Population Growth, 1982-2017 |
|----------------|-----------------|-----------------|------------------------------|
| California     | 24,820,007      | 39,358,497      | 14,538,490                   |
| Texas          | 15,331,408      | 28,295,273      | 12,963,865                   |
| Florida        | 10,471,405      | 20,963,613      | 10,492,208                   |
| Georgia        | 5,649,788       | 10,410,330      | 4,760,542                    |
| North Carolina | 6,019,108       | 10,268,233      | 4,249,125                    |
| Arizona        | 2,889,860       | 7,044,008       | 4,154,148                    |
| Washington     | 4,276,551       | 7,423,362       | 3,146,811                    |
| Virginia       | 5,492,785       | 8,463,587       | 2,970,802                    |
| Colorado       | 3,061,562       | 5,611,885       | 2,550,323                    |
| Nevada         | 881,538         | 2,969,905       | 2,088,367                    |
| Tennessee      | 4,646,043       | 6,708,799       | 2,062,756                    |
| New York       | 17,589,737      | 19,589,572      | 1,999,835                    |
| South Carolina | 3,207,611       | 5,021,268       | 1,813,657                    |
| Maryland       | 4,282,923       | 6,023,868       | 1,740,945                    |
| Utah           | 1,558,314       | 3,101,042       | 1,542,728                    |
| Oregon         | 2,664,919       | 4,143,625       | 1,478,706                    |
| New Jersey     | 7,430,970       | 8,885,525       | 1,454,555                    |
| Minnesota      | 4,131,450       | 5,566,230       | 1,434,780                    |
| Illinois       | 11,423,413      | 12,778,828      | 1,355,415                    |
| Indiana        | 5,467,918       | 6,658,078       | 1,190,160                    |
| Missouri       | 4,929,456       | 6,106,670       | 1,177,214                    |
| Massachusetts  | 5,771,222       | 6,859,789       | 1,088,567                    |
| Wisconsin      | 4,728,862       | 5,790,186       | 1,061,324                    |
| Alabama        | 3,925,263       | 4,874,486       | 949,223                      |
| Pennsylvania   | 11,845,146      | 12,787,641      | 942,495                      |
| Ohio           | 10,757,085      | 11,659,650      | 902,565                      |
| Michigan       | 9,115,196       | 9,973,114       | 857,918                      |
| Kentucky       | 3,683,449       | 4,452,268       | 768,819                      |

| State              | 1982 Population    | 2017 Population    | Population Growth,<br>1982-2017 |
|--------------------|--------------------|--------------------|---------------------------------|
| Idaho              | 973,719            | 1,717,715          | 743,996                         |
| New Mexico         | 1,363,822          | 2,091,784          | 727,962                         |
| Oklahoma           | 3,206,129          | 3,931,316          | 725,187                         |
| Arkansas           | 2,294,254          | 3,001,345          | 707,091                         |
| Kansas             | 2,401,207          | 2,908,718          | 507,511                         |
| Connecticut        | 3,139,014          | 3,573,297          | 434,283                         |
| Mississippi        | 2,556,776          | 2,988,510          | 431,734                         |
| Hawaii             | 993,780            | 1,424,393          | 430,613                         |
| New Hampshire      | 947,720            | 1,348,787          | 401,067                         |
| Delaware           | 599,148            | 956,823            | 357,675                         |
| Nebraska           | 1,581,776          | 1,915,947          | 334,171                         |
| Louisiana          | 4,352,609          | 4,670,560          | 317,951                         |
| Iowa               | 2,888,190          | 3,141,550          | 253,360                         |
| Montana            | 803,984            | 1,052,482          | 248,498                         |
| Maine              | 1,136,683          | 1,334,612          | 197,929                         |
| South Dakota       | 690,597            | 872,868            | 182,271                         |
| Vermont            | 519,108            | 624,344            | 105,236                         |
| Rhode Island       | 954,170            | 1,055,673          | 101,503                         |
| North Dakota       | 668,972            | 754,942            | 85,970                          |
| Wyoming            | 506,400            | 578,931            | 72,531                          |
| West Virginia      | 1,949,605          | 1,817,004          | (132,601)                       |
| <b>Entire USA*</b> | <b>230,580,652</b> | <b>322,126,540</b> | <b>92,970,281</b>               |

*Source:* U.S. Census Bureau population estimates

**\*Note:** Includes all states except Alaska; does not include territories

The three fastest-growing states in absolute population size from 1982 to 2017 – California (14.5 million), Texas (13.0 million), and Florida (10.5 million) – were each far ahead of any of the other 46 states. Each grew by more than twice as fast as the next closest state – Georgia (4<sup>th</sup> place), with 4.8 million.

When ranked by percentage growth over these 35 years (**Table 9**), California drops out of the top ten, while Florida stays in third place and Texas drops to fifth. The first seven states are all “Sunbelt States” in the South and Southwest, with Nevada and Arizona moving into first and second place. Both Nevada and Arizona had relatively small populations in 1982, and by 2017 had more than tripled and more than doubled their numbers, respectively.

**Table 9. Population Change in 49 States, 1982-2017, Ranked By Percentage Growth**

| State          | 1982 Population | 2017 Population | % Population Growth, 1982-2017 |
|----------------|-----------------|-----------------|--------------------------------|
| Nevada         | 881,538         | 2,969,905       | 237%                           |
| Arizona        | 2,889,860       | 7,044,008       | 144%                           |
| Florida        | 10,471,405      | 20,963,613      | 100%                           |
| Utah           | 1,558,314       | 3,101,042       | 99%                            |
| Texas          | 15,331,408      | 28,295,273      | 85%                            |
| Georgia        | 5,649,788       | 10,410,330      | 84%                            |
| Colorado       | 3,061,562       | 5,611,885       | 83%                            |
| Idaho          | 973,719         | 1,717,715       | 76%                            |
| Washington     | 4,276,551       | 7,423,362       | 74%                            |
| North Carolina | 6,019,108       | 10,268,233      | 71%                            |
| Delaware       | 599,148         | 956,823         | 60%                            |
| California     | 24,820,007      | 39,358,497      | 59%                            |
| South Carolina | 3,207,611       | 5,021,268       | 57%                            |
| Oregon         | 2,664,919       | 4,143,625       | 55%                            |
| Virginia       | 5,492,785       | 8,463,587       | 54%                            |
| New Mexico     | 1,363,822       | 2,091,784       | 53%                            |
| Tennessee      | 4,646,043       | 6,708,799       | 44%                            |
| Hawaii         | 993,780         | 1,424,393       | 43%                            |
| New Hampshire  | 947,720         | 1,348,787       | 42%                            |
| Maryland       | 4,282,923       | 6,023,868       | 41%                            |
| Minnesota      | 4,131,450       | 5,566,230       | 35%                            |
| Montana        | 803,984         | 1,052,482       | 31%                            |
| Arkansas       | 2,294,254       | 3,001,345       | 31%                            |

| State              | 1982 Population    | 2017 Population    | % Population Growth, 1982-2017 |
|--------------------|--------------------|--------------------|--------------------------------|
| South Dakota       | 690,597            | 872,868            | 26%                            |
| Alabama            | 3,925,263          | 4,874,486          | 24%                            |
| Missouri           | 4,929,456          | 6,106,670          | 24%                            |
| Oklahoma           | 3,206,129          | 3,931,316          | 23%                            |
| Wisconsin          | 4,728,862          | 5,790,186          | 22%                            |
| Indiana            | 5,467,918          | 6,658,078          | 22%                            |
| Kansas             | 2,401,207          | 2,908,718          | 21%                            |
| Nebraska           | 1,581,776          | 1,915,947          | 21%                            |
| Kentucky           | 3,683,449          | 4,452,268          | 21%                            |
| Vermont            | 519,108            | 624,344            | 20%                            |
| New Jersey         | 7,430,970          | 8,885,525          | 20%                            |
| Massachusetts      | 5,771,222          | 6,859,789          | 19%                            |
| Maine              | 1,136,683          | 1,334,612          | 17%                            |
| Mississippi        | 2,556,776          | 2,988,510          | 17%                            |
| Wyoming            | 506,400            | 578,931            | 14%                            |
| Connecticut        | 3,139,014          | 3,573,297          | 14%                            |
| North Dakota       | 668,972            | 754,942            | 13%                            |
| Illinois           | 11,423,413         | 12,778,828         | 12%                            |
| New York           | 17,589,737         | 19,589,572         | 11%                            |
| Rhode Island       | 954,170            | 1,055,673          | 11%                            |
| Michigan           | 9,115,196          | 9,973,114          | 9%                             |
| Iowa               | 2,888,190          | 3,141,550          | 9%                             |
| Ohio               | 10,757,085         | 11,659,650         | 8%                             |
| Pennsylvania       | 11,845,146         | 12,787,641         | 8%                             |
| Louisiana          | 4,352,609          | 4,670,560          | 7%                             |
| West Virginia      | 1,949,605          | 1,817,004          | -7%                            |
| <b>Entire USA*</b> | <b>230,580,652</b> | <b>323,550,933</b> | <b>40%</b>                     |

Source: U.S. Census Bureau population estimates

\*Note: Includes all states except Alaska; does not include territories

**Table 10. Recent Population Change in 49 States, 2002-2017,  
Ranked By Numerical Growth**

| State          | 2002 Population | 2017 Population | Population Growth,<br>2002-2017 |
|----------------|-----------------|-----------------|---------------------------------|
| Texas          | 21,690,325      | 28,295,273      | 6,604,948                       |
| California     | 34,871,843      | 39,358,497      | 4,486,654                       |
| Florida        | 16,689,370      | 20,963,613      | 4,274,243                       |
| North Carolina | 8,326,201       | 10,268,233      | 1,942,032                       |
| Georgia        | 8,508,256       | 10,410,330      | 1,902,074                       |
| Arizona        | 5,396,255       | 7,044,008       | 1,647,753                       |
| Washington     | 6,052,349       | 7,423,362       | 1,371,013                       |
| Virginia       | 7,286,873       | 8,463,587       | 1,176,714                       |
| Colorado       | 4,490,406       | 5,611,885       | 1,121,479                       |
| South Carolina | 4,107,795       | 5,021,268       | 913,473                         |
| Tennessee      | 5,795,918       | 6,708,799       | 912,881                         |
| Nevada         | 2,173,791       | 2,969,905       | 796,114                         |
| Utah           | 2,324,815       | 3,101,042       | 776,227                         |
| Oregon         | 3,513,424       | 4,143,625       | 630,201                         |
| Maryland       | 5,440,389       | 6,023,868       | 583,479                         |
| Minnesota      | 5,018,935       | 5,566,230       | 547,295                         |
| Indiana        | 6,155,967       | 6,658,078       | 502,111                         |
| Pennsylvania   | 12,331,031      | 12,787,641      | 456,610                         |
| New York       | 19,137,800      | 19,589,572      | 451,772                         |
| Massachusetts  | 6,417,206       | 6,859,789       | 442,583                         |
| Oklahoma       | 3,489,080       | 3,931,316       | 442,236                         |
| Missouri       | 5,674,825       | 6,106,670       | 431,845                         |
| Alabama        | 4,480,089       | 4,874,486       | 394,397                         |
| Idaho          | 1,340,372       | 1,717,715       | 377,343                         |
| Kentucky       | 4,089,875       | 4,452,268       | 362,393                         |
| Wisconsin      | 5,445,162       | 5,790,186       | 345,024                         |
| New Jersey     | 8,552,643       | 8,885,525       | 332,882                         |

| State              | 2002 Population    | 2017 Population    | Population Growth, 2002-2017 |
|--------------------|--------------------|--------------------|------------------------------|
| Arkansas           | 2,705,927          | 3,001,345          | 295,418                      |
| Illinois           | 12,525,556         | 12,778,828         | 253,272                      |
| Ohio               | 11,407,889         | 11,659,650         | 251,761                      |
| New Mexico         | 1,855,309          | 2,091,784          | 236,475                      |
| Iowa               | 2,934,234          | 3,141,550          | 207,316                      |
| Kansas             | 2,713,535          | 2,908,718          | 195,183                      |
| Nebraska           | 1,728,292          | 1,915,947          | 187,655                      |
| Hawaii             | 1,239,613          | 1,424,393          | 184,780                      |
| Louisiana          | 4,497,267          | 4,670,560          | 173,293                      |
| Delaware           | 806,169            | 956,823            | 150,654                      |
| Montana            | 911,667            | 1,052,482          | 140,815                      |
| Mississippi        | 2,858,681          | 2,988,510          | 129,829                      |
| North Dakota       | 638,168            | 754,942            | 116,774                      |
| Connecticut        | 3,458,749          | 3,573,297          | 114,548                      |
| South Dakota       | 760,020            | 872,868            | 112,848                      |
| New Hampshire      | 1,269,089          | 1,348,787          | 79,698                       |
| Wyoming            | 500,017            | 578,931            | 78,914                       |
| Maine              | 1,295,960          | 1,334,612          | 38,652                       |
| West Virginia      | 1,805,414          | 1,817,004          | 11,590                       |
| Vermont            | 615,442            | 624,344            | 8,902                        |
| Rhode Island       | 1,065,995          | 1,055,673          | (10,322)                     |
| Michigan           | 10,015,710         | 9,973,114          | (42,596)                     |
| <b>Entire USA*</b> | <b>286,409,698</b> | <b>323,550,933</b> | <b>37,141,235</b>            |

*Source:* U.S. Census Bureau population estimates

**\*Note:** Includes all states except Alaska; does not include territories

Texas had by far the greatest numerical population growth of all the states between 2002 and 2017, some 6.6 million, 47 percent more than its closest competitor, California (4.5 million).

**Table 11. Recent Population Change in 49 States, 2002-2017, Ranked By % Growth**

| State          | 2002 Population | 2017 Population | % Population Growth, 2002-2017 |
|----------------|-----------------|-----------------|--------------------------------|
| Nevada         | 2,173,791       | 2,969,905       | 37%                            |
| Utah           | 2,324,815       | 3,101,042       | 33%                            |
| Arizona        | 5,396,255       | 7,044,008       | 31%                            |
| Texas          | 21,690,325      | 28,295,273      | 30%                            |
| Idaho          | 1,340,372       | 1,717,715       | 28%                            |
| Florida        | 16,689,370      | 20,963,613      | 26%                            |
| Colorado       | 4,490,406       | 5,611,885       | 25%                            |
| North Carolina | 8,326,201       | 10,268,233      | 23%                            |
| Washington     | 6,052,349       | 7,423,362       | 23%                            |
| Georgia        | 8,508,256       | 10,410,330      | 22%                            |
| South Carolina | 4,107,795       | 5,021,268       | 22%                            |
| Delaware       | 806,169         | 956,823         | 19%                            |
| North Dakota   | 638,168         | 754,942         | 18%                            |
| Oregon         | 3,513,424       | 4,143,625       | 18%                            |
| Virginia       | 7,286,873       | 8,463,587       | 16%                            |
| Wyoming        | 500,017         | 578,931         | 16%                            |
| Tennessee      | 5,795,918       | 6,708,799       | 16%                            |
| Montana        | 911,667         | 1,052,482       | 15%                            |
| Hawaii         | 1,239,613       | 1,424,393       | 15%                            |
| South Dakota   | 760,020         | 872,868         | 15%                            |
| California     | 34,871,843      | 39,358,497      | 13%                            |
| New Mexico     | 1,855,309       | 2,091,784       | 13%                            |
| Oklahoma       | 3,489,080       | 3,931,316       | 13%                            |
| Arkansas       | 2,705,927       | 3,001,345       | 11%                            |
| Minnesota      | 5,018,935       | 5,566,230       | 11%                            |
| Nebraska       | 1,728,292       | 1,915,947       | 11%                            |
| Maryland       | 5,440,389       | 6,023,868       | 11%                            |
| Kentucky       | 4,089,875       | 4,452,268       | 9%                             |

| State              | 2002 Population    | 2017 Population    | % Population Growth, 2002-2017 |
|--------------------|--------------------|--------------------|--------------------------------|
| Alabama            | 4,480,089          | 4,874,486          | 9%                             |
| Indiana            | 6,155,967          | 6,658,078          | 8%                             |
| Missouri           | 5,674,825          | 6,106,670          | 8%                             |
| Kansas             | 2,713,535          | 2,908,718          | 7%                             |
| Iowa               | 2,934,234          | 3,141,550          | 7%                             |
| Massachusetts      | 6,417,206          | 6,859,789          | 7%                             |
| Wisconsin          | 5,445,162          | 5,790,186          | 6%                             |
| New Hampshire      | 1,269,089          | 1,348,787          | 6%                             |
| Mississippi        | 2,858,681          | 2,988,510          | 5%                             |
| New Jersey         | 8,552,643          | 8,885,525          | 4%                             |
| Louisiana          | 4,497,267          | 4,670,560          | 4%                             |
| Pennsylvania       | 12,331,031         | 12,787,641         | 4%                             |
| Connecticut        | 3,458,749          | 3,573,297          | 3%                             |
| Maine              | 1,295,960          | 1,334,612          | 3%                             |
| New York           | 19,137,800         | 19,589,572         | 2%                             |
| Ohio               | 11,407,889         | 11,659,650         | 2%                             |
| Illinois           | 12,525,556         | 12,778,828         | 2%                             |
| Vermont            | 615,442            | 624,344            | 1%                             |
| West Virginia      | 1,805,414          | 1,817,004          | 1%                             |
| Michigan           | 10,015,710         | 9,973,114          | 0%                             |
| Rhode Island       | 1,065,995          | 1,055,673          | -1%                            |
| <b>Entire USA*</b> | <b>285,170,085</b> | <b>322,126,540</b> | <b>13%</b>                     |

*Source:* U.S. Census Bureau population estimates

*\*Note:* Includes all states except Alaska; does not include territories

The three fastest-growing states in the entire country by percentage from 2002 to 2017 – Nevada, Utah, and Arizona – are all located in the arid Southwest, which as pointed out in Section 1.9 “Water Woes,” is already facing severe water scarcity issues that are only expected to worsen as the century proceeds.










### 2.3.1 Sources of U.S. Population Growth

The population growth of the United States during the years covered in this study can be measured in two sources:<sup>95</sup>

- **Natural Increase:** births in the United States minus deaths in the United States over the period 1982-2017.
- **Net migration:** number of people who moved to the United States from 1982-2017, minus those who had moved out or died by 2017.

Table 11b lists the top ten countries of origin of U.S. immigrants in 2016.

**Table 11b: Top Ten Country of Origin of U.S. Foreign-born Population, 2016**

|   | Country            | Millions | % U.S. Foreign-born |
|---|--------------------|----------|---------------------|
|    | Mexico             | 11.6     | 26.5%               |
|    | China              | 2.7      | 6.2%                |
|    | India              | 2.4      | 5.6%                |
|    | Philippines        | 1.9      | 4.4%                |
|    | El Salvador        | 1.4      | 3.1%                |
|   | Viet Nam           | 1.4      | 3.1%                |
|  | Cuba               | 1.3      | 2.9%                |
|  | Dominican Republic | 1.1      | 2.5%                |
|  | Korea              | 1.0      | 2.4%                |
|  | Guatemala          | 0.9      | 2.1%                |

Source: Pew Research Center<sup>96</sup>

To measure the total contribution of net migration to U.S. population growth, descendants of immigrants born in the United States are included (both children and grandchildren). Obviously, that percentage depends on the starting year used in the calculation. According to demographer Joseph Chamie writing in 2006, 58% of population increase since the founding of the United States has been the “result of migration (that is, U.S. immigrants and their descendants).”<sup>97</sup>

<sup>95</sup> The estimates of population growth are taken from Steven A. Camarota and Karen Zeigler, “Estimating the Impact of Immigration on U.S. Population Growth 1982 to 2017,” Center for Immigration Studies, February 25, 2022, <https://cis.org/Camarota/Estimating-Impact-Immigration-US-Population-Growth-1982-2017>.

<sup>96</sup> Abby Budiman, “Key findings about U.S. immigrants,” Pew Research Center, Table: Country of Birth 2016, August 20, 2020, [https://assets.pewresearch.org/wp-content/uploads/sites/7/2018/09/06132756/PH\\_2016-Foreign-Born-Statistical-Portraits\\_Current-Data\\_5\\_Country-of-birth.png](https://assets.pewresearch.org/wp-content/uploads/sites/7/2018/09/06132756/PH_2016-Foreign-Born-Statistical-Portraits_Current-Data_5_Country-of-birth.png).

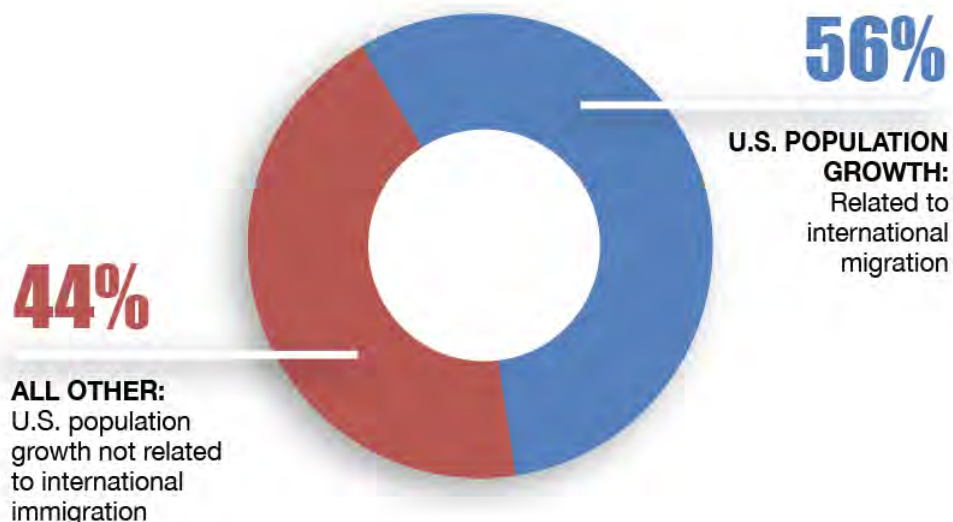
<sup>97</sup> Joseph Chamie, “American Migration: 1776 to 2006: What would the U.S. population look like without immigration?” *The Globalist*, November 29, 2006, <https://www.theglobalist.com/american-migration-1776-to-2006/>.

In order to estimate how much immigration has contributed to U.S. population growth and thus to the loss of open space due to that population growth from 1982 to 2017, one has to account for immigrants who arrived in the United States during that time period, and the children and grandchildren born to those immigrants. Using Census Bureau survey data, including the 2017 American Community Survey (ACS) and the 1999 and 2017 Current Population Survey Annual Social and Economic Supplements (CPS ASEC), Steven A. Camarota and Karen Zeigler of the Center for Immigration Studies provided such a demographic analysis.

They found that:

“There were 35.78 million legal and illegal immigrants living in the United States who arrived from 1982 to 2017. Further, these immigrants had 16.93 million U.S.-born children and grandchildren. In total, immigration added 52.7 million people to the U.S. population between 1982 and 2017, accounting for a little over 56 percent of population growth over this time period.”<sup>98</sup>

**Figure 46a** shows that from 1982 to 2017, international migration to the United States was responsible for 56% of total U.S. population growth.

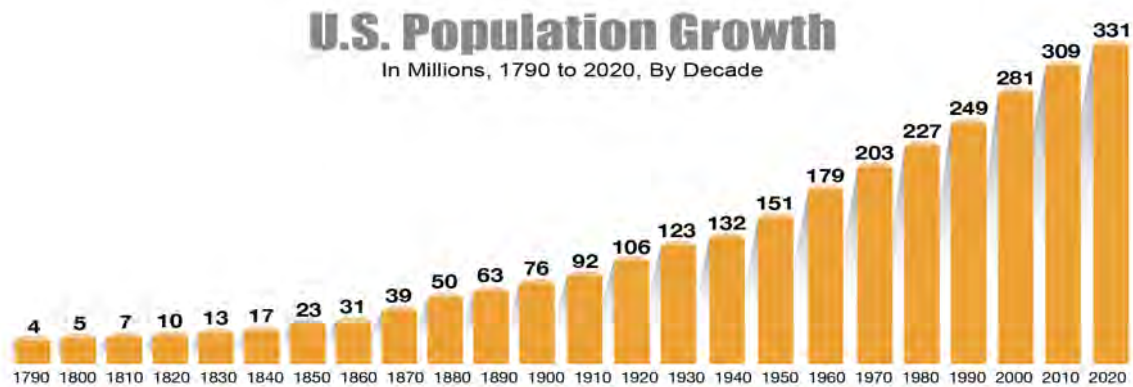


**Figure 46a: Percentage of U.S. Population Growth Due Directly and Indirectly to International Migration, 1982 to 2017**

Source: Center for Immigration Studies

Following the release of the 2020 Census numbers, there was much discussion in the media about the rate of U.S. population growth and very little about total population growth from 2010 to 2020, which was 22.7 million. Figure 46b shows total U.S. population growth from the very first official Census in 1790 to 2020, according to the decennial census counts. It is important to point out that even with a growth rate below 1% from 2010 to 2020, the United States still added over 20 million additional residents because of the large size of its total population.

<sup>98</sup> Camarota and Zeigler. “Estimating the Impact of Immigration on U.S. Population Growth 1982 to 2017.”



**Figure 46b: U.S. Population Growth from 1790 to 2020\***

\*As counted in the decadal U.S. Census

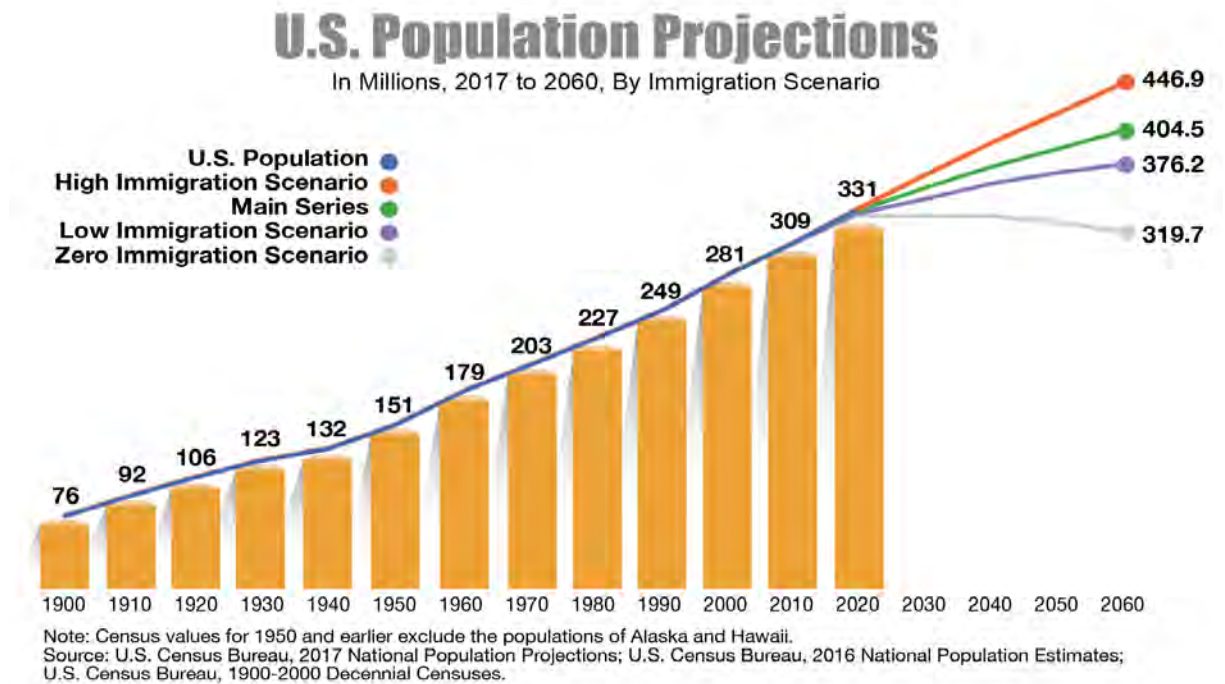
As to future population growth in the United States, Figure 46c from the U.S. Census Bureau indicates that projected future U.S. population growth will largely be determined by future immigration levels, not natural increase (i.e., the births minus deaths), which are not likely to vary substantially.<sup>99</sup> Under the “zero immigration” scenario, U.S. population would actually decline by 2060 from present levels. At the other extreme, it would increase to almost 447 million, an increase of about 115 million from the 2022 population.

The "low immigration scenario" and "main series" would lead to intermediate population increases, both resulting in substantially larger populations than at present. Demographic projections made in 2015 by the Pew Research Center indicated that future immigration would comprise some 88% of the projected U.S. population growth to 2060 and if anything, declines in the U.S. birthrate since then, in conjunction with increased immigration rates (both legal and illegal) under the Biden administration, suggest that immigration would constitute 90% or more of U.S. population growth for the foreseeable future.<sup>100</sup> More recently (2019), the Center for Immigration Studies has estimated that future immigration will account for 95% of U.S. population growth to 2060.<sup>101</sup>

<sup>99</sup> Sandra Johnson, “A Changing Nation: Population Projections Under Alternative Immigration Scenarios,” U.S. Census Bureau, P25-1146, February 2020, <https://www.census.gov/library/publications/2020/demo/p25-1146.html>.

<sup>100</sup> Modern Immigration Wave Brings 59 Million to U.S., Driving Population Growth and Change Through 2065,” September 28, 2015, Pew Research Center, September 28, 2015, <https://www.pewresearch.org/hispanic/2015/09/28/modern-immigration-wave-brings-59-million-to-u-s-driving-population-growth-and-change-through-2065/>

<sup>101</sup> Steven A. Camarota and Karen Zeigler, “Projecting the Impact of Immigration on the U.S. Population: A look at size and age structure through 2060,” *Backgrounder*, Center for Immigration Studies, February 4, 2019, <https://cis.org/Report/Projecting-Impact-Immigration-US-Population>.



**Figure 46c: Projected U.S. Population Growth to 2060 Under Different Immigration Scenarios According to the U.S. Census Bureau**

In the population projections chart, the line for **Main Series** is the Census Bureau’s assumption of the most likely scenario based on an immigration flow similar to 2011-2015. The **High Immigration Scenario** is based on net immigration roughly 50 percent higher than in the Main Series. The **Low Immigration Scenario** is based on immigration that is roughly half the Main Series. The **Zero Immigration Scenario** is based on no in-migration but a continuation of out-migration.

Both the High and Low immigration scenarios are political possibilities. Competing congressional bills that would *reduce* annual immigration by around half and that would *increase* immigration by 50 percent or more have received strong support at various times during the last decade. The Zero Immigration Scenario, however, is not based on any support in Congress; no proposed legislation the last decade would even cut annual admissions of around one million by more than half. But the Zero Immigration Scenario does provide a hypothetical view that helps us assess how much of future population growth is expected to be caused by immigration.

## 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 can lead to urban sprawl. In general, around the United States, the increase in per capita land consumption (Per Capita Sprawl) is an important cause of Overall Sprawl in many cities and counties. The NRI combined with

Census data on the nation's Developed Land allow us to track trends 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
  - Areal extent of the entire built-up urbanized land area comprised of non-residential land uses, such as industrial, institutional, government, commercial, etc.
- **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

**Table 12** shows per capita land consumption in the 49 states in 1982, 2002, and 2015. The two right-hand columns show changes in per capita urbanized or developed land consumption from 1982 to 2017 and from 2002 to 2017.

**Table 12. Per Capita Developed Land Consumption in 49 States in 1982, 2002, and 2017**

| State       | 1982 Per Capita Land Consumption (acres) | 2002 Per Capita Land Consumption (acres) | 2017 Per Capita Land Consumption (acres) | % Change – 1982 to 2017 | % Change – 2002 to 2017 |
|-------------|--|--|--|-------------------------|-------------------------|
| Alabama     | 0.418                                    | 0.587                                    | 0.602                                    | 44.0%                   | 2.7%                    |
| Arizona     | 0.340                                    | 0.323                                    | 0.298                                    | -12.4%                  | -7.7%                   |
| Arkansas    | 0.531                                    | 0.613                                    | 0.627                                    | 18.0%                   | 2.3%                    |
| California  | 0.165                                    | 0.165                                    | 0.160                                    | -3.2%                   | -3.2%                   |
| Colorado    | 0.393                                    | 0.394                                    | 0.352                                    | -10.4%                  | -10.7%                  |
| Connecticut | 0.269                                    | 0.301                                    | 0.305                                    | 13.3%                   | 1.2%                    |
| Delaware    | 0.267                                    | 0.306                                    | 0.312                                    | 17.0%                   | 2.0%                    |
| Florida     | 0.269                                    | 0.295                                    | 0.267                                    | -0.6%                   | -9.4%                   |
| Georgia     | 0.394                                    | 0.492                                    | 0.454                                    | 15.3%                   | -7.7%                   |
| Hawaii      | 0.166                                    | 0.173                                    | 0.543                                    | 6.7%                    | 1.9%                    |
| Idaho       | 0.576                                    | 0.612                                    | 0.273                                    | -5.6%                   | -11.3%                  |
| Illinois    | 0.231                                    | 0.258                                    | 0.384                                    | 18.3%                   | 5.6%                    |
| Indiana     | 0.327                                    | 0.380                                    | 0.625                                    | 17.5%                   | 1.1%                    |
| Iowa        | 0.568                                    | 0.628                                    | 0.735                                    | 10.1%                   | -0.5%                   |
| Kansas      | 0.723                                    | 0.749                                    | 0.482                                    | 1.6%                    | -1.9%                   |
| Kentucky    | 0.307                                    | 0.476                                    | 0.428                                    | 56.7%                   | 1.2%                    |
| Louisiana   | 0.284                                    | 0.393                                    | 0.656                                    | 50.7%                   | 8.9%                    |
| Maine       | 0.443                                    | 0.607                                    | 0.255                                    | 48.1%                   | 8.1%                    |

| State          | 1982 Per Capita Land Consumption (acres) | 2002 Per Capita Land Consumption (acres) | 2017 Per Capita Land Consumption (acres) | % Change – 1982 to 2017 | % Change – 2002 to 2017 |
|----------------|--|--|--|-------------------------|-------------------------|
| Maryland       | 0.227                                    | 0.260                                    | 0.259                                    | 12.1%                   | -1.8%                   |
| Massachusetts  | 0.193                                    | 0.261                                    | 0.424                                    | 34.4%                   | -0.6%                   |
| Michigan       | 0.309                                    | 0.395                                    | 0.442                                    | 37.2%                   | 7.3%                    |
| Minnesota      | 0.418                                    | 0.456                                    | 0.652                                    | 5.7%                    | -3.1%                   |
| Mississippi    | 0.457                                    | 0.595                                    | 0.602                                    | 42.5%                   | 9.5%                    |
| Missouri       | 0.440                                    | 0.491                                    | 0.494                                    | 12.4%                   | 0.7%                    |
| Montana        | 1.062                                    | 1.116                                    | 1.064                                    | 0.2%                    | -4.7%                   |
| Nebraska       | 0.692                                    | 0.699                                    | 0.662                                    | -4.4%                   | -5.3%                   |
| Nevada         | 0.244                                    | 0.197                                    | 0.183                                    | -25.0%                  | -7.1%                   |
| New Hampshire  | 0.424                                    | 0.530                                    | 0.547                                    | 29.0%                   | 3.2%                    |
| New Jersey     | 0.159                                    | 0.207                                    | 0.211                                    | 32.4%                   | 1.5%                    |
| New Mexico     | 0.527                                    | 0.658                                    | 0.655                                    | 24.4%                   | -0.5%                   |
| New York       | 0.162                                    | 0.192                                    | 0.199                                    | 23.0%                   | 3.6%                    |
| North Carolina | 0.392                                    | 0.527                                    | 0.479                                    | 22.2%                   | -9.2%                   |
| North Dakota   | 1.358                                    | 1.525                                    | 1.401                                    | 3.1%                    | -8.2%                   |
| Ohio           | 0.265                                    | 0.343                                    | 0.362                                    | 36.8%                   | 5.7%                    |
| Oklahoma       | 0.463                                    | 0.555                                    | 0.562                                    | 21.4%                   | 1.4%                    |
| Oregon         | 0.366                                    | 0.377                                    | 0.342                                    | -6.7%                   | -9.4%                   |

| State              | 1982 Per Capita Land Consumption (acres) | 2002 Per Capita Land Consumption (acres) | 2017 Per Capita Land Consumption (acres) | % Change – 1982 to 2017 | % Change – 2002 to 2017 |
|--------------------|--|--|--|-------------------------|-------------------------|
| Pennsylvania       | 0.235                                    | 0.340                                    | 0.353                                    | 49.7%                   | 3.7%                    |
| Rhode Island       | 0.179                                    | 0.206                                    | 0.222                                    | 23.9%                   | 7.8%                    |
| South Carolina     | 0.426                                    | 0.589                                    | 0.544                                    | 27.8%                   | -7.7%                   |
| South Dakota       | 1.180                                    | 1.241                                    | 1.118                                    | -5.2%                   | -9.9%                   |
| Tennessee          | 0.354                                    | 0.485                                    | 0.470                                    | 32.7%                   | -3.1%                   |
| Texas              | 0.345                                    | 0.362                                    | 0.337                                    | -2.3%                   | -7.0%                   |
| Utah               | 0.303                                    | 0.317                                    | 0.299                                    | -1.2%                   | -5.6%                   |
| Vermont            | 0.508                                    | 0.604                                    | 0.652                                    | 28.4%                   | 7.9%                    |
| Virginia           | 0.335                                    | 0.395                                    | 0.382                                    | 14.1%                   | -3.2%                   |
| Washington         | 0.376                                    | 0.387                                    | 0.341                                    | -9.5%                   | -12.1%                  |
| West Virginia      | 0.327                                    | 0.601                                    | 0.643                                    | 96.3%                   | 6.9%                    |
| Wisconsin          | 0.419                                    | 0.470                                    | 0.482                                    | 14.9%                   | 2.6%                    |
| Wyoming            | 1.058                                    | 1.285                                    | 1.203                                    | 13.7%                   | -6.4%                   |
| <b>Entire USA*</b> | <b>0.313</b>                             | <b>0.364</b>                             | <b>0.358</b>                             | <b>14.8%</b>            | <b>-1.8%</b>            |

Source: 2017 NRI and U.S. Census Bureau population estimates

\*Note: Includes all states except Alaska; does not include territories

Unsurprisingly, heavily populated California, with high urban population densities, has the lowest per capita developed or urban land consumption of the 49 states, with 0.160 acre per person (per capita) in 2017. That is a density of 6.25 people per acre. Also unsurprisingly, the four states with the highest per capita developed land consumption are all low-population and low-population-density states: North Dakota (1.401 acres per person), Wyoming (1.203), South Dakota (1.118), and Montana (1.064). California's developed areas are almost nine times as densely populated as North Dakota's.

Comparing the aggregate, 49-state population growth values in **Table 9** and the aggregate, 49-state change in per capita land consumption values in **Table 12**, what immediately stands out is that between 1982 and 2017, the population increased by 40 percent while per capita land consumption increased by only 14 percent. This divergence between the two underlying factors that drive sprawl is even more pronounced in the 2002-2017 dataset: between 2002 and 2017 the population of the 49 states **increased** by 13 percent (**Table 11**), while the per land consumption in the same shorter, more recent time period actually **decreased** by 2 percent (**Table 12**). These findings suggest that population growth is the more significant of the two underlying factors driving continuing urban sprawl in the 21<sup>st</sup> century.

## 2.5 Measuring Overall Sprawl

Using the National Resources Inventory (Developed Land) data in conjunction with U.S. Census Bureau county population estimates for the years 1982, 2002, and 2017, we were able to measure the overall amount different American counties sprawled, along with what portion 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. We then aggregated all the counties in a given state – with those counties experiencing more population change (usually growth) and sprawl – proportionately weighted more heavily, to estimate the percentage of a given state's overall sprawl attributable to population growth and the percentage related to growth in per capita land consumption.

For example, looking at the state of Connecticut in the 2002 to 2017 time period, we see that the state's population increased from 3,458,749 to 3,573,297, or by 3.3%. During this same time period, the area of Developed Land in the entire state grew from 1,041,000 acres to 1,088,900 acres, or by 47,900 acres (what we call Overall Sprawl), an increase of 4.6%. Using these gross figures for the state, and the apportioning formula described in the next section and in Appendix C, it is evident population growth accounted for 72 percent of the Overall Sprawl from 2002 to 2017 in Connecticut. The remaining 28 percent was related to growth in Per Capita Land Consumption, or what we call Per Capita Sprawl for short.

We also use a more granular, conservative or cautious approach. This one considers each county in a state distinctly, calculates the percentage of Overall Sprawl in each county related

to population growth, and then adds up the counties. Counties are weighted in proportion with the amount of sprawl that occurred in those counties. Using this approach, between 2002 and 2017, 63 percent of the Overall Sprawl in Connecticut was due to population growth, and 37 percent to per capita sprawl.

**Figure 46.**  
**Squantz Pond,**  
**Connecticut**



### 3. FINDINGS

This study focuses on the loss of previously undeveloped or rural, non-federal land (including cropland, pastureland, rangeland, forest, and other natural habitat and open space) in the 48 contiguous United States, plus Hawaii. The Natural Resources Conservation Service (NRCS) and the National Resources Inventory (NRI) do not maintain a longitudinal (over time) Developed Land inventory for the largest state of all, Alaska, which, if measured, would be shown to contain by far the lowest percentage of Developed Land of any state in the union, in part, because Alaska possesses by far the lowest population density. At 1.3 residents per square mile, Alaska's population density is almost 1,000 times lower than the most densely populated state, New Jersey, at 1,210 per square mile, and more than four times lower than the next least-densely-populated state, Wyoming, at 6.0 residents per square mile.

At its most basic level, there are three reasons for an increase in the area of developed or urbanized land: 1) each individual, on average, is consuming more developed land; 2) there are more people; or 3) a combination of both factors is working together to create sprawl. This study attempts to quantify the relative roles of the two fundamental factors behind sprawl: rising per capita land consumption (that is, declining population density) and population growth. As noted in the previous chapter, we use county and state-level data from the NRI and county and state population estimates for 1982, 2002, and 2017 from the U.S. Census Bureau to accomplish this.

#### 3.1 Per Capita Sprawl and Overall Sprawl

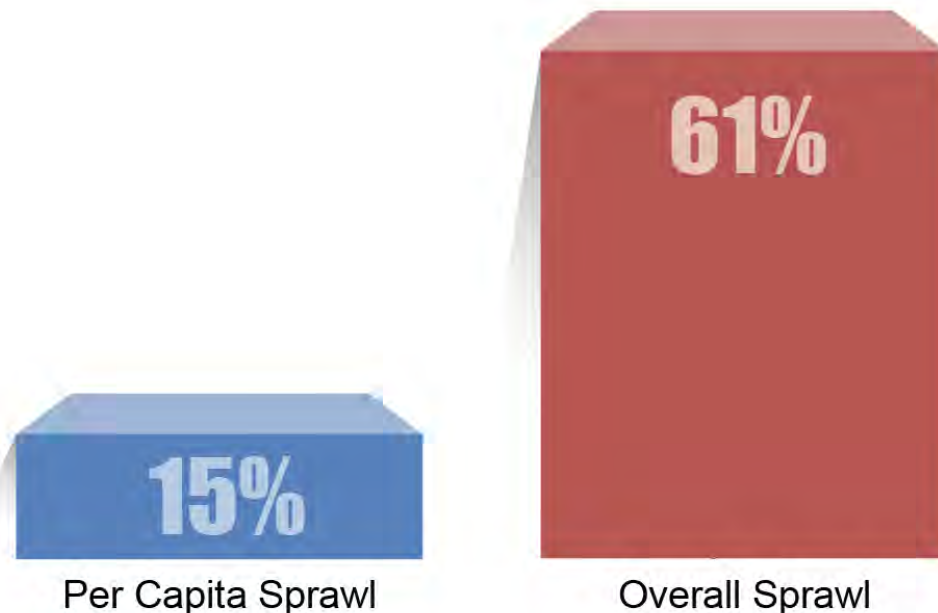
Many respected environmental organizations and urban planners contend that implementing Smart Growth, New Urbanism, and LEED<sup>102</sup> building strategies into our new and existing cities is the best way to curb sprawl in American cities. However, this is based on the premise that it is only or primarily our land-use choices that cause sprawl in the United States. As our multiple studies over the past two decades demonstrate conclusively, Per Capita Sprawl by itself could not explain Overall Sprawl in the great majority of America's urbanized or developed areas.

By comparing the percentage growth or change of per capita land consumption (Per Capita Sprawl) with the percentage growth of Overall Sprawl in the 49 states from 1982 to 2017 in **Figure 47**, we find that the Per Capita Sprawl percentage is much smaller than the Overall Sprawl percentage: 15 percent versus 61 percent. This is not to denigrate Smart Growth, New

---

<sup>102</sup> 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>

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 couple of decades. Given incessant population growth, however, they will be capable only of slowing sprawl, not stopping it.



**Figure 47. Per Capita Sprawl vs. Overall Sprawl in 49 U.S. States, 1982-2017**

Note: Per Capita Sprawl is % growth in per capita urbanized land consumption and Overall Sprawl is % growth in urbanized land area.

**Table 13** compares the percentages of Per Capita Sprawl and Overall Sprawl from 1982 to 2017 in all 49 American states in our study. In all cases but one (the anomaly of West Virginia, the only state which had a smaller population in 2017 than it did in 1982), Per Capita Sprawl is smaller than Overall Sprawl, in many cases much smaller. In 12 of the 49 states, the Per Capita Sprawl value is negative, meaning that overall population density increased in developed areas, and that per capita developed land consumption on average shrank in those states.

**Table 13. Per Capita Sprawl vs. Overall Sprawl**  
**49 U.S. States – 1982 to 2017**

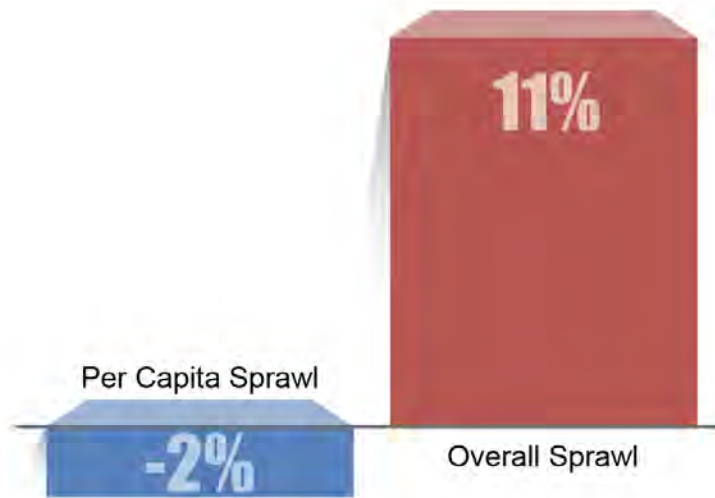
| <b>State</b> | <b>% Change in Per Capita Land Consumption, 1982-2017 (PER CAPITA SPRAWL)</b> | <b>% Change in Overall Land Consumption, 1982-2017 (OVERALL SPRAWL)</b> |
|--------------|---|---|
| Alabama      | 44.0%   | 78.9%   |
| Arizona      | -12.4%  | 113.6%  |
| Arkansas     | 18.0%   | 54.3%   |
| California   | -3.2%   | 53.4%   |
| Colorado     | -10.4%  | 64.2%   |
| Connecticut  | 13.3%   | 28.9%   |
| Delaware     | 17.0%   | 86.8%   |
| Florida      | -0.6%   | 99.0%   |
| Georgia      | 15.3%   | 112.4%  |
| Hawaii       | 6.7%  | 53.0%   |
| Idaho        | -5.6%   | 66.5%   |
| Illinois     | 18.3%   | 32.4%   |
| Indiana      | 17.5%   | 43.1%   |
| Iowa         | 10.1%   | 19.7%   |
| Kansas       | 1.6%  | 23.1%   |
| Kentucky     | 56.7%   | 89.4%   |
| Louisiana    | 50.7%   | 61.7%   |

| State          | % Change in Per Capita Land Consumption, 1982-2017 (PER CAPITA SPRAWL) | % Change in Overall Land Consumption, 1982-2017 (OVERALL SPRAWL) |
|----------------|--|--|
| Maine          | 48.1%  | 73.9%  |
| Maryland       | 12.1%  | 57.6%  |
| Massachusetts  | 34.4%  | 59.7%  |
| Michigan       | 37.2%  | 50.2%  |
| Minnesota      | 5.7%   | 42.5%  |
| Mississippi    | 42.5%  | 66.6%  |
| Missouri       | 12.4%  | 39.3%  |
| Montana        | 0.2%   | 31.2%  |
| Nebraska       | -4.4%  | 15.8%  |
| Nevada         | -25.0%   | 152.8%   |
| New Hampshire  | 29.0%  | 83.6%  |
| New Jersey     | 32.4%  | 58.3%  |
| New Mexico     | 24.4%  | 90.8%  |
| New York       | 23.0%  | 37.0%  |
| North Carolina | 22.2%  | 108.4%   |
| North Dakota   | 3.1%   | 16.4%  |
| Ohio           | 36.8%  | 48.3%  |
| Oklahoma       | 21.4%  | 48.8%  |

| State              | % Change in Per Capita Land Consumption, 1982-2017 (PER CAPITA SPRAWL) | % Change in Overall Land Consumption, 1982-2017 (OVERALL SPRAWL) |
|--------------------|--|--|
| Oregon             | -6.7%  | 45.1%  |
| Pennsylvania       | 49.7%  | 61.6%  |
| Rhode Island       | 23.9%  | 37.0%  |
| South Carolina     | 27.8%  | 100.1%   |
| South Dakota       | -5.2%  | 19.8%  |
| Tennessee          | 32.7%  | 91.6%  |
| Texas              | -2.3%  | 80.3%  |
| Utah               | -1.2%  | 96.5%  |
| Vermont            | 28.4%  | 54.4%  |
| Virginia           | 14.1%  | 75.9%  |
| Washington         | -9.5%  | 57.1%  |
| West Virginia      | 96.3%  | 83.0%  |
| Wisconsin          | 14.9%  | 40.7%  |
| Wyoming            | 13.7%  | 30.0%  |
| <b>Entire USA*</b> | <b>14.8%</b>   | <b>61.1%</b>   |

If anything, in the more recent 15-year, 2002-2017 study period (a subset of the longer, 35-year, 1982-2017 period), the discrepancy between Per Capita Sprawl (-2%) and Overall Sprawl (11%) was even more pronounced (**Figure 48**). Per Capita Sprawl actually declined by 2% during 2002 to 2017, meaning that average population density in the nation's Developed Land areas increased, not decreased, as it had for many previous decades since the post-World War II population and economic boom that began in earnest in the 1950s, leading to a long era of

what was dubbed “low-density sprawl.” The low-density dominant aspect of sprawl has now diminished or disappeared, but sprawl continues, albeit not exactly in an unabated form; it continues at a somewhat slower, steadier pace.



**Figure 48. Recent Per Capita Sprawl vs. Overall Sprawl in 49 U.S. States, 2002-2017**

Note: Per Capita Sprawl is % growth in per capita urbanized land consumption and Overall Sprawl is % growth in urbanized land area.

**Table 14. Recent Per Capita Sprawl vs. Overall Sprawl  
49 U.S. States – 2002 to 2017**

| State       | % Change in Per Capita Land Consumption, 2002-2017 (PER CAPITA SPRAWL) | % Change in Overall Land Consumption, 2002-2017 (OVERALL SPRAWL) |
|-------------|--|--|
| Alabama     | 2.7%   | 11.7%  |
| Arizona     | -7.7%  | 20.4%  |
| Arkansas    | 2.3%   | 13.4%  |
| California  | -3.2%  | 9.2%   |
| Colorado    | -10.7%   | 11.6%  |
| Connecticut | 1.2%   | 4.6%   |
| Delaware    | 2.0%   | 21.0%  |

| State         | % Change in Per Capita Land Consumption, 2002-2017 (PER CAPITA SPRAWL) | % Change in Overall Land Consumption, 2002-2017 (OVERALL SPRAWL) |
|---------------|--|--|
| Florida       | -9.4%  | 13.9%  |
| Georgia       | -7.7%  | 12.9%  |
| Hawaii        | 1.9%   | 17.1%  |
| Idaho         | -11.3%   | 13.7%  |
| Illinois      | 5.6%   | 7.7%   |
| Indiana       | 1.1%   | 9.3%   |
| Iowa          | -0.5%  | 6.6%   |
| Kansas        | -1.9%  | 5.1%   |
| Kentucky      | 1.2%   | 10.2%  |
| Louisiana     | 8.9%   | 13.1%  |
| Maine         | 8.1%   | 11.3%  |
| Maryland      | -1.8%  | 8.7%   |
| Massachusetts | -0.6%  | 6.2%   |
| Michigan      | 7.3%   | 6.9%   |
| Minnesota     | -3.1%  | 7.4%   |
| Mississippi   | 9.5%   | 14.5%  |
| Missouri      | 0.7%   | 8.4%   |
| Montana       | -4.7%  | 10.0%  |

| State          | % Change in Per Capita Land Consumption, 2002-2017 (PER CAPITA SPRAWL) | % Change in Overall Land Consumption, 2002-2017 (OVERALL SPRAWL) |
|----------------|--|--|
| Nebraska       | -5.3%  | 5.0%   |
| Nevada         | -7.1%  | 27.0%  |
| New Hampshire  | 3.2%   | 9.7%   |
| New Jersey     | 1.5%   | 5.5%   |
| New Mexico     | -0.5%  | 12.2%  |
| New York       | 3.6%   | 6.0%   |
| North Carolina | -9.2%  | 12.0%  |
| North Dakota   | -8.2%  | 8.7%   |
| Ohio           | 5.7%   | 8.0%   |
| Oklahoma       | 1.4%   | 14.2%  |
| Oregon         | -9.4%  | 6.8%   |
| Pennsylvania   | 3.7%   | 7.6%   |
| Rhode Island   | 7.8%   | 6.8%   |
| South Carolina | -7.7%  | 12.9%  |
| South Dakota   | -9.9%  | 3.5%   |
| Tennessee      | -3.1%  | 12.2%  |
| Texas          | -7.0%  | 21.3%  |
| Utah           | -5.6%  | 25.9%  |

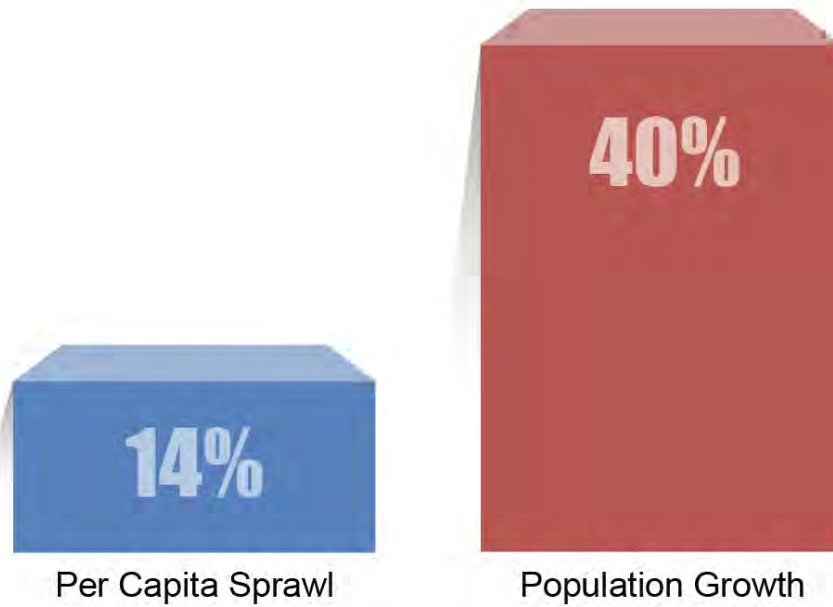
| State              | % Change in Per Capita Land Consumption, 2002-2017 (PER CAPITA SPRAWL) | % Change in Overall Land Consumption, 2002-2017 (OVERALL SPRAWL) |
|--------------------|--|--|
| Vermont            | 7.9%   | 9.5%   |
| Virginia           | -3.2%  | 12.5%  |
| Washington         | -12.1%   | 7.9%   |
| West Virginia      | 6.9%   | 7.6%   |
| Wisconsin          | 2.6%   | 9.1%   |
| Wyoming            | -6.4%  | 8.4%   |
| <b>Entire USA*</b> | <b>-1.8%</b>   | <b>10.9%</b>   |

Even the best Smart Growth, New Urbanism, and LEED strategies are able to engineer only so much population density. With the Covid-19 pandemic in 2020-2021, millions of Americans became all too acquainted with two of the perils of density: the much easier spread of contagious diseases and the unprecedented, economically and socially costly restraints on personal and economic freedom deemed crucial to containing epidemics. More populous and more densely populated states like California and New York suffered more from the highly restrictive government response to the pandemic than lower-density states like Montana and South Dakota. As long as the population is still growing, the land area taken up by American towns and cities will continue to grow.

### 3.2 Per Capita Sprawl vs. Population Growth

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

**Figure 49** aggregates the 49 states and finds that their average population increase from 1982 to 2017 was 40 percent while their per capita land consumption increase was 14 percent. Thus we can see that the rate of population growth was a much larger factor than the rate of per capita land consumption growth in U.S. urban sprawl in from 1982 to 2017.



**Figure 49. Per Capita Sprawl vs. Population Growth in 49 States, 1982-2017**

Description: When comparing the growth rates of the two factors behind Overall Sprawl we find that population growth was much greater than per growth in capita land consumption from 1982 to 2017.

**Table 15. Per Capita Sprawl Increase vs. Population Increase, 49 U.S. States – 1982 to 2017**

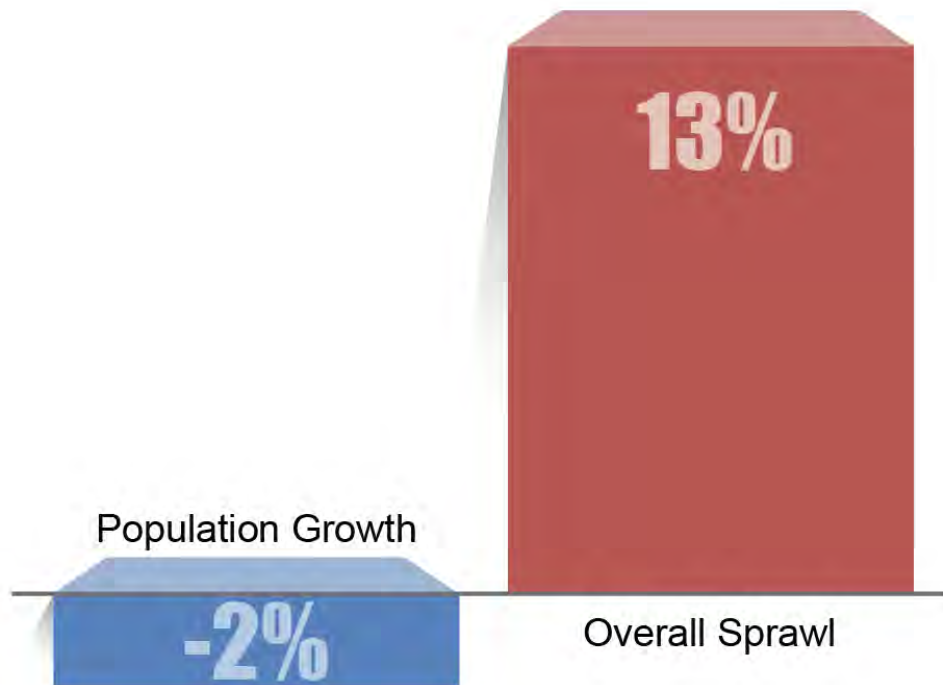
| State       | % Change in Per Capita Land Consumption, 1982-2017 (PER CAPITA SPRAWL) | % Change in Population, 1982-2017 |
|-------------|--|-----------------------------------|
| Alabama     | 44.0%  | 24.2%                             |
| Arizona     | -12.4%   | 143.7%                            |
| Arkansas    | 18.0%  | 30.8%                             |
| California  | -3.2%  | 58.6%                             |
| Colorado    | -10.4%   | 83.3%                             |
| Connecticut | 13.3%  | 13.8%                             |
| Delaware    | 17.0%  | 59.7%                             |
| Florida     | -0.6%  | 100.2%                            |

| State         | % Change in Per Capita Land Consumption,<br>1982-2017<br>(PER CAPITA SPRAWL) | % Change in Population,<br>1982-2017 |
|---------------|--|--------------------------------------|
| Georgia       | 15.3%  | 84.3%                                |
| Hawaii        | 6.7%   | 43.3%                                |
| Idaho         | -5.6%  | 76.4%                                |
| Illinois      | 18.3%  | 11.9%                                |
| Indiana       | 17.5%  | 21.8%                                |
| Iowa          | 10.1%  | 8.8%                                 |
| Kansas        | 1.6%   | 21.1%                                |
| Kentucky      | 56.7%  | 20.9%                                |
| Louisiana     | 50.7%  | 7.3%                                 |
| Maine         | 48.1%  | 17.4%                                |
| Maryland      | 12.1%  | 40.6%                                |
| Massachusetts | 34.4%  | 18.9%                                |
| Michigan      | 37.2%  | 9.4%                                 |
| Minnesota     | 5.7%   | 34.7%                                |
| Mississippi   | 42.5%  | 16.9%                                |
| Missouri      | 12.4%  | 23.9%                                |
| Montana       | 0.2%   | 30.9%                                |
| Nebraska      | -4.4%  | 21.1%                                |
| Nevada        | -25.0%   | 236.9%                               |
| New Hampshire | 29.0%  | 42.3%                                |

| State          | % Change in Per Capita Land Consumption, 1982-2017 (PER CAPITA SPRAWL) | % Change in Population, 1982-2017 |
|----------------|--|-----------------------------------|
| New Jersey     | 32.4%  | 19.6%                             |
| New Mexico     | 24.4%  | 53.4%                             |
| New York       | 23.0%  | 11.4%                             |
| North Carolina | 22.2%  | 70.6%                             |
| North Dakota   | 3.1%   | 12.9%                             |
| Ohio           | 36.8%  | 8.4%                              |
| Oklahoma       | 21.4%  | 22.6%                             |
| Oregon         | -6.7%  | 55.5%                             |
| Pennsylvania   | 49.7%  | 8.0%                              |
| Rhode Island   | 23.9%  | 10.6%                             |
| South Carolina | 27.8%  | 56.5%                             |
| South Dakota   | -5.2%  | 26.4%                             |
| Tennessee      | 32.7%  | 44.4%                             |
| Texas          | -2.3%  | 84.6%                             |
| Utah           | -1.2%  | 99.0%                             |
| Vermont        | 28.4%  | 20.3%                             |
| Virginia       | 14.1%  | 54.1%                             |
| Washington     | -9.5%  | 73.6%                             |
| West Virginia  | 96.3%  | -6.8%                             |
| Wisconsin      | 14.9%  | 22.4%                             |

| State              | % Change in Per Capita Land Consumption, 1982-2017 (PER CAPITA SPRAWL) | % Change in Population, 1982-2017 |
|--------------------|--|-----------------------------------|
| Wyoming            | 13.7%  | 14.3%                             |
| <b>Entire USA*</b> | <b>13.8%</b>   | <b>40.3%</b>                      |

Examining the more recent 2002 to 2017 time period, the divergence widens even further. Per capita land consumption actually turned negative, declining by -2% in this period, while population increased by 13% (Figure 50 and Table 16).



**Figure 50. Recent Per Capita Sprawl vs. Population Growth in 49 States, 2002-2017**  
 Description: When comparing the growth rates of the two factors behind Overall Sprawl we find that population growth was much greater than per growth in capita land consumption from 2002 to 2017.

**Table 16. Recent Per Capita Sprawl Increase vs. Population Increase,  
49 U.S. States – 2002 to 2017**

| <b>State</b> | <b>% Change in Per Capita<br/>Land Consumption,<br/>2002-2017<br/>(PER CAPITA SPRAWL)</b> | <b>% Change in Population,<br/>2002-2017</b> |
|--------------|---|--|
| Alabama      | 2.7%  | 8.8%   |
| Arizona      | -7.7%   | 30.5%  |
| Arkansas     | 2.3%  | 10.9%  |
| California   | -3.2%   | 12.9%  |
| Colorado     | -10.7%  | 25.0%  |
| Connecticut  | 1.2%  | 3.3%   |
| Delaware     | 2.0%  | 18.7%  |
| Florida      | -9.4%   | 25.6%  |
| Georgia      | -7.7%   | 22.4%  |
| Hawaii       | 1.9%  | 14.9%  |
| Idaho        | -11.3%  | 28.2%  |
| Illinois     | 5.6%  | 2.0%   |
| Indiana      | 1.1%  | 8.2%   |
| Iowa         | -0.5%   | 7.1%   |
| Kansas       | -1.9%   | 7.2%   |
| Kentucky     | 1.2%  | 8.9%   |
| Louisiana    | 8.9%  | 3.9%   |

| State          | % Change in Per Capita Land Consumption, 2002-2017<br>(PER CAPITA SPRAWL) | % Change in Population, 2002-2017 |
|----------------|---|-----------------------------------|
| Maine          | 8.1%  | 3.0%                              |
| Maryland       | -1.8%   | 10.7%                             |
| Massachusetts  | -0.6%   | 6.9%                              |
| Michigan       | 7.3%  | -0.4%                             |
| Minnesota      | -3.1%   | 10.9%                             |
| Mississippi    | 9.5%  | 4.5%                              |
| Missouri       | 0.7%  | 7.6%                              |
| Montana        | -4.7%   | 15.4%                             |
| Nebraska       | -5.3%   | 10.9%                             |
| Nevada         | -7.1%   | 36.6%                             |
| New Hampshire  | 3.2%  | 6.3%                              |
| New Jersey     | 1.5%  | 3.9%                              |
| New Mexico     | -0.5%   | 12.7%                             |
| New York       | 3.6%  | 2.4%                              |
| North Carolina | -9.2%   | 23.3%                             |
| North Dakota   | -8.2%   | 18.3%                             |
| Ohio           | 5.7%  | 2.2%                              |
| Oklahoma       | 1.4%  | 12.7%                             |

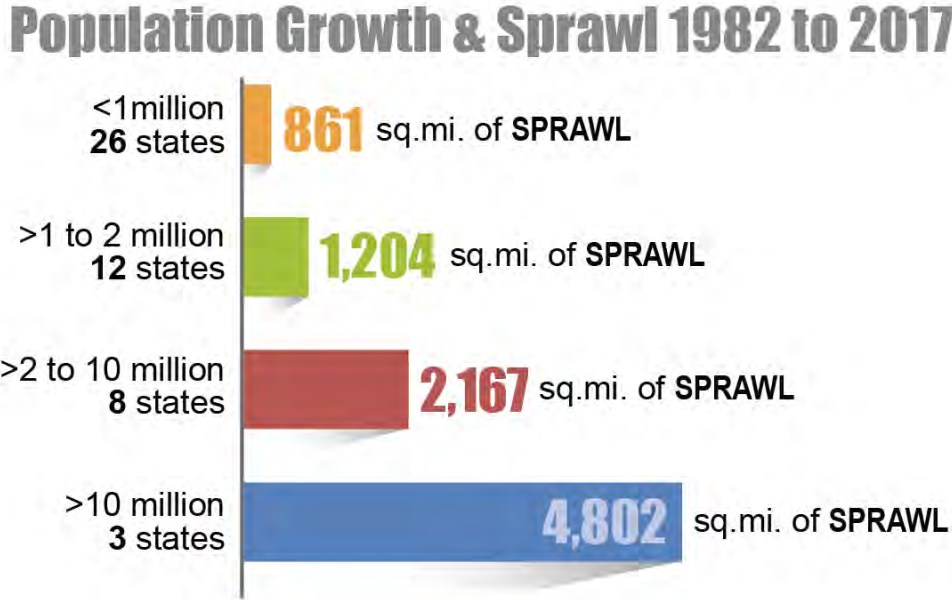
| State              | % Change in Per Capita Land Consumption, 2002-2017<br>(PER CAPITA SPRAWL) | % Change in Population, 2002-2017 |
|--------------------|---|-----------------------------------|
| Oregon             | -9.4%   | 17.9%                             |
| Pennsylvania       | 3.7%  | 3.7%                              |
| Rhode Island       | 7.8%  | -1.0%                             |
| South Carolina     | -7.7%   | 22.2%                             |
| South Dakota       | -9.9%   | 14.8%                             |
| Tennessee          | -3.1%   | 15.8%                             |
| Texas              | -7.0%   | 30.5%                             |
| Utah               | -5.6%   | 33.4%                             |
| Vermont            | 7.9%  | 1.4%                              |
| Virginia           | -3.2%   | 16.1%                             |
| Washington         | -12.1%  | 22.7%                             |
| West Virginia      | 6.9%  | 0.6%                              |
| Wisconsin          | 2.6%  | 6.3%                              |
| Wyoming            | -6.4%   | 15.8%                             |
| <b>Entire USA*</b> | <b>-1.8%</b>  | <b>13.0%</b>                      |

### 3.3 Population Growth Drives Most Sprawl

Since our primary concern is the ongoing loss of rural lands throughout the United States – 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.

The findings of the current updated study broadly reinforce one of the conclusions of our original sprawl studies two decades ago – that when investigating the causes of sprawl, and presenting findings, it is best to avoid absolutes or categorical statements. Unlike some who studied the sprawl phenomenon, we attribute sprawl neither to population growth entirely nor to declining population density exclusively, that is, to increasing per capita land consumption. Once again, our newest, updated findings based on the newest developed land datasets clearly indicate that both factors are involved and important, although it is increasingly evident in recent years that the population growth factor substantially outweighs the Per Capita Sprawl factor in importance.

**Figure 51** compares the amount or physical area of sprawl when the 49 states are divided into four groups based on their aggregate population growth from 1982 to 2017. The four groups are: greater than 10 million (> 10 million) population growth, 2 million to 10 million (>2 <10 million), 1 million to 2 million (>1 <2 million), and under one million (< 1 million). In general, states that added more population clearly sprawled over greater land areas, although in a somewhat more complex manner than may at first be evident.



**Figure 51. States with More Population Growth Experienced More Sprawl**

Those three states (California, Texas, Florida) whose populations grew by more than 10 million from 1982 to 2017 averaged 4,802 square miles of sprawl (3,073,280 acres) each (**Table 17**). Those eight states whose populations grew between 2 million and 10 million averaged 2,167 square miles of sprawl (1,386,880 acres). Those 12 states whose populations grew between 1 million and 2 million averaged 1,204 square miles of sprawl (770,560 acres). Finally, those 26 states whose populations grew by under 1 million averaged 861 square miles of sprawl (551,040 acres).

**Table 17. States with More Population Growth Had Less Sprawl Per Capita, 1982 to 2017**

| Amount State Population Grew, 1982-2017 | Average Pop. Growth in Category | Average Sprawl in Category (acres) | Acres of Sprawl Per Person |
|---|---------------------------------|------------------------------------|----------------------------|
| > 10 million population growth          | 12,664,854                      | 3,073,280                          | 0.24                       |
| >2 <10 million                          | 3,247,859                       | 1,386,880                          | 0.43                       |
| >1 <2 million                           | 1,444,824                       | 770,560                            | 0.53                       |
| < 1 million                             | 448,268                         | 551,040                            | 1.23                       |

The “Acres of Sprawl Per Person” column in **Table 17** shows a five-fold difference in population density – 0.24 acre/person versus 1.23 acres/person – between the states with the most population growth (>10 million) and the states with the least population growth (< 1 million). States that added the most population did so at a density five times higher than those that added the least population. Yet because the population growth in those states averaged **28 times** as much as the lowest-population-growth states (12.7 million versus 0.45 million), the average area of sprawl in the highest-population-density states was almost six times greater (3,073,280 acres versus 551,040 acres).

When population growth pressures are high in a given locale, region, or state, various public and private (political and market) forces and influences combine to increase relative population density (reduce per capita land consumption). The net effect, thankfully, is to constrain the march of urban sprawl and slow the conversion and loss of rural lands and open space. However, these forces and influences are not nearly powerful enough to halt sprawl entirely. If they were, we would not have suffered the loss of nearly 18,000 square miles (11.4 million acres) of open space, farmland, and natural habitat from 2002 to 2017 alone.

### 3.4 Relative Weight of Sprawl Factors

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. Physicist John Holdren, Ph.D., former Director of the White House Office of

Science and Technology Policy and former president of the American Association for the Advancement of Science (AAAS), 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.<sup>103</sup> This method can be applied to virtually any type of natural 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 have our other studies over the past two decades, applies this method to sprawl. Rural, undeveloped land is thus the natural 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 the increase in per capita land consumption (Per Capita Sprawl) and how much is related to the increase in the number of land consumers (Population Growth).

**Table 18** applies this apportioning method to all Developed Land in the 49 states covered in our study. For any given state, the values for “Total Sprawl” (second column) in this table are obtained by subtracting the total area of NRI Developed Land in 1982 from the area in 2017. Similarly, population growth for that state is obtained by subtracting the 1982 population estimate from the 2017 population estimate (from the U.S. Census Bureau). Using this method, we then determine the percentage of sprawl (area of rural land “consumed” and converted to developed land) in that state related to population growth and the percentage related to increasing per capita land consumption.

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<sup>103</sup> John P. Holdren. 1991. “Population and the Energy Problem.” *Population and Environment*, Vol. 12, No. 3, Spring 1991. Prior to being Director of the White House Office of Science and Technology Policy in the Obama Administration between 2009 and 2017, 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.

**Table 18. Sources of Sprawl in America's Developed Areas, 1982-2017**

| <b>State</b> | <b>Total Sprawl<br/>1982 to 2017<br/>(square miles)</b> | <b>% of Total<br/>Sprawl Related to<br/>POPULATION<br/>GROWTH</b> | <b>% of Total Sprawl<br/>Related to GROWTH<br/>IN PER CAPITA<br/>LAND<br/>CONSUMPTION</b> |
|--------------|---|---|---|
| Alabama      | 2,023   | 37%   | 63%   |
| Arizona      | 1,744   | 100%*   | 0%  |
| Arkansas     | 1,035   | 62%   | 38%   |
| California   | 3,420   | 100%  | 0%  |
| Colorado     | 1,206   | 100%  | 0%  |
| Connecticut  | 382   | 51%   | 49%   |
| Delaware     | 217   | 75%   | 25%   |
| Florida      | 4,353   | 100%  | 0%  |
| Georgia      | 3,910   | 81%   | 19%   |
| Hawaii       | 136   | 85%   | 15%   |
| Idaho        | 583   | 100%  | 0%  |
| Illinois     | 1,332   | 40%   | 60%   |
| Indiana      | 1,203   | 55%   | 45%   |
| Iowa         | 505   | 47%   | 53%   |
| Kansas       | 627   | 92%   | 8%  |
| Kentucky     | 1,583   | 30%   | 70%   |

| State          | Total Sprawl<br>1982 to 2017<br>(square miles) | % of Total<br>Sprawl Related to<br>POPULATION<br>GROWTH | % of Total Sprawl<br>Related to GROWTH<br>IN PER CAPITA<br>LAND<br>CONSUMPTION |
|----------------|--|---|--|
| Louisiana      | 1,192  | 15%   | 85%  |
| Maine          | 581  | 29%   | 71%  |
| Maryland       | 877  | 75%   | 25%  |
| Massachusetts  | 1,038  | 37%   | 63%  |
| Michigan       | 2,208  | 22%   | 78%  |
| Minnesota      | 1,146  | 84%   | 16%  |
| Mississippi    | 1,217  | 31%   | 69%  |
| Missouri       | 1,330  | 65%   | 35%  |
| Montana        | 416  | 99%   | 1%   |
| Nebraska       | 270  | 100%  | 0%   |
| Nevada         | 514  | 100%  | 0%   |
| New Hampshire  | 525  | 58%   | 42%  |
| New Jersey     | 1,077  | 39%   | 61%  |
| New Mexico     | 1,019  | 66%   | 34%  |
| New York       | 1,642  | 34%   | 66%  |
| North Carolina | 3,995  | 73%   | 27%  |
| North Dakota   | 233  | 80%   | 20%  |
| Ohio           | 2,149  | 20%   | 80%  |

| State             | Total Sprawl<br>1982 to 2017<br>(square miles) | % of Total<br>Sprawl Related to<br>POPULATION<br>GROWTH | % of Total Sprawl<br>Related to GROWTH<br>IN PER CAPITA<br>LAND<br>CONSUMPTION |
|-------------------|--|---|--|
| Oklahoma          | 1,133  | 51%   | 49%  |
| Oregon            | 688  | 100%  | 0%   |
| Pennsylvania      | 2,686  | 16%   | 84%  |
| Rhode Island      | 99   | 32%   | 68%  |
| South Carolina    | 2,136  | 65%   | 35%  |
| South Dakota      | 252  | 100%  | 0%   |
| Tennessee         | 2,354  | 57%   | 43%  |
| Texas             | 6,634  | 100%  | 0%   |
| Utah              | 713  | 100%  | 0%   |
| Vermont           | 224  | 42%   | 58%  |
| Virginia          | 2,180  | 77%   | 23%  |
| Washington        | 1,436  | 100%  | 0%   |
| West Virginia     | 827  | 0%  | 100%   |
| Wisconsin         | 1,261  | 59%   | 41%  |
| Wyoming           | 251  | 51%   | 49%  |
| <b>Entire USA</b> | <b>68,561</b>                                  | <b>71%</b>  | <b>29%</b>   |

\* In this table, any mathematical values greater than 100% were automatically set back to 100%, in keeping with the view that neither population growth nor increase in per capita land consumption can account for more than all of sprawl.

There is a good deal of variation from state to state, with population growth estimated to account for 100 percent of the sprawl in 12 states and, at the other extreme, zero percent in one state –West Virginia, which still sprawled 827 square miles even as it lost population. Yet overall, the trend is clear: population growth accounted for most of the sprawl between 1982 and 2017, 71 percent, to be precise. Growth in per capita land consumption, declining population density (a.k.a. “low-density sprawl,” or as we call it, Per Capita Sprawl) accounted for 29 percent, or just over one-quarter of urban sprawl.

That value represents a high-end estimate of population’s role in driving sprawl. We can obtain a somewhat lower, and we believe, more accurate assessment by disaggregating population growth and developed land growth values by county, examining each county in a state individually, and then aggregating their effects on sprawl to derive an overall estimate for the state as a whole. This county-by-county weighting approach accounts for the sprawl that occurs in each county and lends a proportionately greater weight to those counties with greater amounts of sprawl. For example, the factors driving sprawl in mostly rural areas of the State of Washington, such as Okanogan County, on the east side of the Cascades, should not be attributed to or lumped in with the distinct factors driving sprawl in geographically distant King County, dominated by the large city of Seattle, its neighboring cities and suburbs. The Seattle metro area’s population growth and sprawl do not induce sprawl in Okanogan County.

In this method, the amount of sprawl related to population growth in each county is summed for all counties in a state, 39 in the State of Washington, for example. This sum or aggregate is then divided by the total amount of sprawl in the state. Using this procedure, 91 percent of the sprawl in Washington between 1982 and 2017 is shown to be associated with population growth, which the authors believe is a more accurate estimate of population growth’s role than 122 percent, the purely mathematical value which exaggerates population’s role, and which implies that all sprawl (and then some) in Washington is related to population growth; this is not the case.

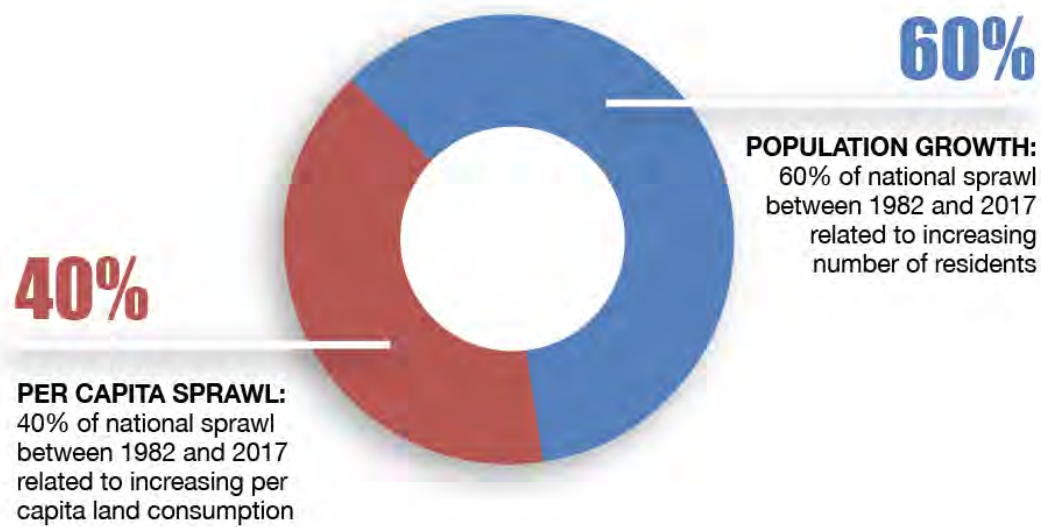
The results of this more conservative, weighted approach are shown in **Table 19** and **Figure 52**. Here, the percentage of sprawl related to population growth in the 49 states from 1982 to 2017 is 60 percent, as opposed to 72 percent in the previous approach. In both approaches, population growth accounts for well over half of all urban sprawl.

**Table 19. Percentage of Sprawl by State Related to Population Growth, Using More Conservative, Weighted Approach, 1982-2017**

| State       | Total Sprawl 1982 to 2017 (square miles) | Sprawl Related to POPULATION GROWTH (square miles) | % Sprawl from Population Growth |
|-------------|--|--|---------------------------------|
| Alabama     | 2,023                                    | 760  | 38%                             |
| Arizona     | 1,744                                    | 1,614  | 93%                             |
| Arkansas    | 1,035                                    | 600  | 58%                             |
| California  | 3,420                                    | 3,166  | 93%                             |
| Colorado    | 1,206                                    | 1,039  | 86%                             |
| Connecticut | 382                                      | 204  | 53%                             |
| Delaware    | 217                                      | 184  | 85%                             |
| Florida     | 4,353                                    | 3,888  | 89%                             |
| Georgia     | 3,910                                    | 2,553  | 65%                             |
| Hawaii      | 136                                      | 127  | 93%                             |
| Idaho       | 583                                      | 450  | 77%                             |
| Illinois    | 1,332                                    | 672  | 50%                             |
| Indiana     | 1,203                                    | 615  | 51%                             |
| Iowa        | 505                                      | 213  | 42%                             |
| Kansas      | 627                                      | 326  | 52%                             |
| Kentucky    | 1,583                                    | 550  | 35%                             |
| Louisiana   | 1,192                                    | 364  | 31%                             |
| Maine       | 581                                      | 158  | 27%                             |

| State          | Total Sprawl 1982 to 2017 (square miles) | Sprawl Related to POPULATION GROWTH (square miles) | % Sprawl from Population Growth |
|----------------|--|--|---------------------------------|
| Maryland       | 877                                      | 701  | 80%                             |
| Massachusetts  | 1,038                                    | 410  | 39%                             |
| Michigan       | 2,208                                    | 941  | 43%                             |
| Minnesota      | 1,146                                    | 805  | 70%                             |
| Mississippi    | 1,217                                    | 466  | 38%                             |
| Missouri       | 1,330                                    | 880  | 66%                             |
| Montana        | 416                                      | 244  | 59%                             |
| Nebraska       | 270                                      | 159  | 59%                             |
| Nevada         | 514                                      | 425  | 83%                             |
| New Hampshire  | 525                                      | 295  | 56%                             |
| New Jersey     | 1,077                                    | 502  | 47%                             |
| New Mexico     | 1,019                                    | 482  | 47%                             |
| New York       | 1,642                                    | 424  | 26%                             |
| North Carolina | 3,995                                    | 2,405  | 60%                             |
| North Dakota   | 233                                      | 95   | 41%                             |
| Ohio           | 2,149                                    | 722  | 34%                             |
| Oklahoma       | 1,133                                    | 467  | 41%                             |
| Oregon         | 688                                      | 574  | 83%                             |
| Pennsylvania   | 2,686                                    | 879  | 33%                             |

| State             | Total Sprawl 1982 to 2017 (square miles) | Sprawl Related to POPULATION GROWTH (square miles) | % Sprawl from Population Growth |
|-------------------|--|--|---------------------------------|
| Rhode Island      | 99                                       | 36   | 37%                             |
| South Carolina    | 2,136                                    | 1,262  | 59%                             |
| South Dakota      | 252                                      | 143  | 57%                             |
| Tennessee         | 2,354                                    | 1,291  | 55%                             |
| Texas             | 6,634                                    | 4,637  | 70%                             |
| Utah              | 713                                      | 587  | 82%                             |
| Vermont           | 224                                      | 83   | 37%                             |
| Virginia          | 2,180                                    | 1,438  | 66%                             |
| Washington        | 1,436                                    | 1,306  | 91%                             |
| West Virginia     | 827                                      | 151  | 18%                             |
| Wisconsin         | 1,261                                    | 735  | 58%                             |
| Wyoming           | 251                                      | 118  | 47%                             |
| <b>Entire USA</b> | <b>68,561</b>                            | <b>41,140</b>                                      | <b>60%</b>                      |



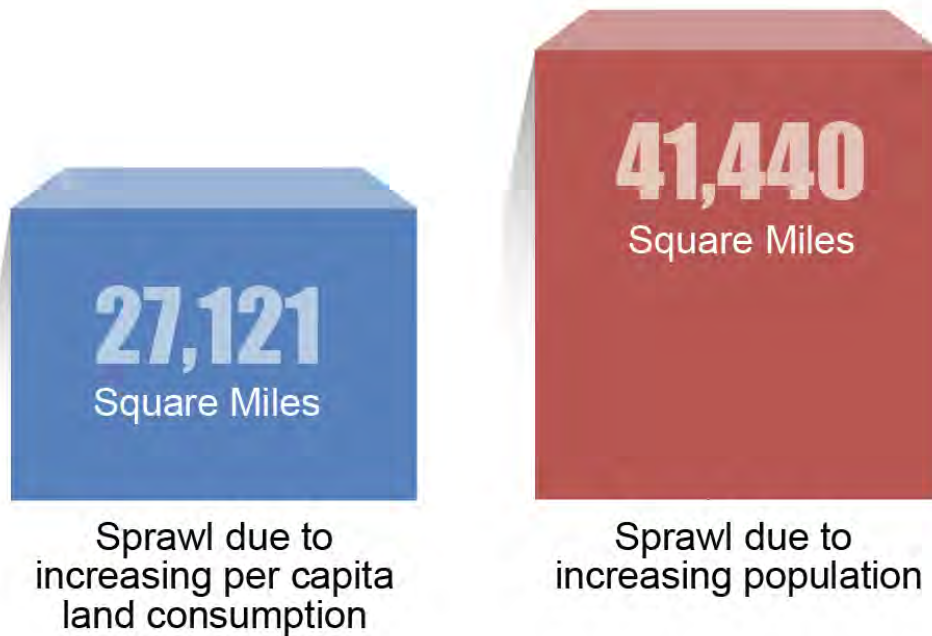
**Figure 52. Sprawl Factors (Increasing Population and Increasing Per Capita Land Consumption) in 49 States, 1982-2017**

*Sources:* Analysis of Developed Land estimates from NRCS National Resources Inventory, 2017; population estimates for 1982 and 2017 for each American county and state from U.S. Census Bureau population estimates.

**Description:** Approximately 40 percent of the sprawl in America’s towns and cities was related to increasing per capita land consumption. Approximately 60 percent of the sprawl was related to population growth.

Unlike Census Bureau data for Urbanized Areas, the NRCS’ NRI inventory encompasses 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. Finally, on a national scale, the NRI category of Developed Land called “Rural Transportation” accounted for almost 20 percent of all developed land in 2017.

Between 1982 and 2017, U.S. developed areas surged across and consumed an additional 68,561 square miles (44 million acres) of land in aggregate. For a sense of scale, this is an area **20 times larger** than Yellowstone National Park, our very first and still one of our largest National Parks. **Figure 53** shows that population growth accounted for 41,440 of these square miles, compared to 27,121 square miles related to Per Capita Sprawl or rising land consumption per capita.



**Figure 53. Rural Land Lost to Per Capita Sprawl vs. Population Growth in 49 States, 1982-2017**

The results of applying the same more conservative sprawl apportioning methodology to the 49 states in our study for the 2002 to 2017 time period are presented in **Table 20**.

**Table 20. Percentage of Recent Sprawl by State Related to Population Growth, Using More Conservative, Weighted Approach, 2002-2017**

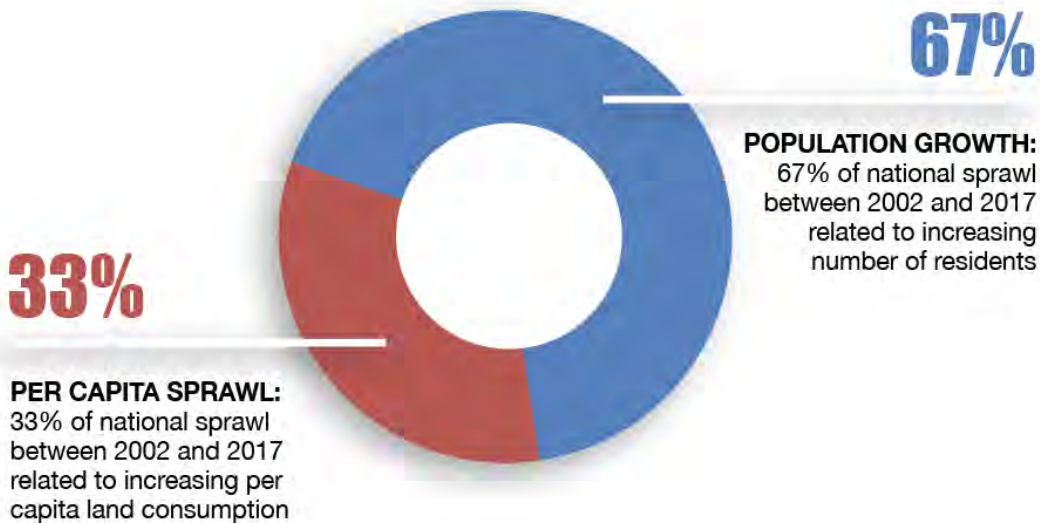
| State       | Total Sprawl 2002 to 2017 (square miles) | Sprawl Related to POPULATION GROWTH (square miles) | % Sprawl from Population Growth |
|-------------|--|--|---------------------------------|
| Alabama     | 481                                      | 259  | 54%                             |
| Arizona     | 557                                      | 465  | 84%                             |
| Arkansas    | 348                                      | 197  | 57%                             |
| California  | 831                                      | 718  | 86%                             |
| Colorado    | 321                                      | 277  | 86%                             |
| Connecticut | 75                                       | 42   | 56%                             |

| <b>State</b>  | <b>Total Sprawl<br/>2002 to 2017<br/>(square miles)</b> | <b>Sprawl Related to<br/>POPULATION<br/>GROWTH (square<br/>miles)</b> | <b>% Sprawl from<br/>Population<br/>Growth</b> |
|---------------|---|---|--|
| Delaware      | 81  | 69  | 85%  |
| Florida       | 1,065   | 1,012   | 95%  |
| Georgia       | 846   | 673   | 80%  |
| Hawaii        | 58  | 57  | 98%  |
| Idaho         | 176   | 146   | 83%  |
| Illinois      | 391   | 183   | 47%  |
| Indiana       | 341   | 168   | 49%  |
| Iowa          | 189   | 95  | 50%  |
| Kansas        | 162   | 79  | 49%  |
| Kentucky      | 311   | 156   | 50%  |
| Louisiana     | 362   | 175   | 48%  |
| Maine         | 139   | 37  | 26%  |
| Maryland      | 192   | 172   | 90%  |
| Massachusetts | 163   | 110   | 67%  |
| Michigan      | 426   | 167   | 39%  |
| Minnesota     | 266   | 170   | 64%  |
| Mississippi   | 385   | 158   | 41%  |
| Missouri      | 365   | 243   | 67%  |
| Montana       | 160   | 105   | 65%  |
| Nebraska      | 94  | 55  | 59%  |
| Nevada        | 181   | 138   | 76%  |

| <b>State</b>   | <b>Total Sprawl<br/>2002 to 2017<br/>(square miles)</b> | <b>Sprawl Related to<br/>POPULATION<br/>GROWTH (square<br/>miles)</b> | <b>% Sprawl from<br/>Population<br/>Growth</b> |
|----------------|---|---|--|
| New Hampshire  | 102   | 65  | 63%  |
| New Jersey     | 153   | 76  | 50%  |
| New Mexico     | 232   | 129   | 55%  |
| New York       | 346   | 75  | 22%  |
| North Carolina | 821   | 628   | 76%  |
| North Dakota   | 132   | 94  | 72%  |
| Ohio           | 490   | 176   | 36%  |
| Oklahoma       | 431   | 231   | 54%  |
| Oregon         | 141   | 124   | 87%  |
| Pennsylvania   | 496   | 254   | 51%  |
| Rhode Island   | 23  | 0   | 2%   |
| South Carolina | 487   | 393   | 81%  |
| South Dakota   | 51  | 39  | 76%  |
| Tennessee      | 534   | 358   | 67%  |
| Texas          | 2,616   | 1,910   | 73%  |
| Utah           | 299   | 278   | 93%  |
| Vermont        | 55  | 12  | 21%  |
| Virginia       | 560   | 393   | 70%  |
| Washington     | 288   | 276   | 96%  |

| State             | Total Sprawl 2002 to 2017 (square miles) | Sprawl Related to POPULATION GROWTH (square miles) | % Sprawl from Population Growth |
|-------------------|--|--|---------------------------------|
| West Virginia     | 129                                      | 49   | 38%                             |
| Wisconsin         | 362                                      | 193  | 53%                             |
| Wyoming           | 84                                       | 69   | 82%                             |
| <b>Entire USA</b> | <b>17,793</b>                            | <b>11,945</b>                                      | <b>67%</b>                      |

During this more recent period (2002-2017), population growth accounted for a higher percentage of sprawl – 67 percent, or two-thirds (**Figure 54**) – than the 60 percent of the entire period (1982-2017). This is consistent with what we have observed in other recent national, regional, and state studies on sprawl, including for Florida, Texas, Oregon, Arizona, and the Piedmont Region. In the 21<sup>st</sup> century to date, the rate of sprawl has decreased somewhat from that of the last two decades of the 20<sup>th</sup> century because of a variety of factors, but the percentage of that sprawl due to population growth has increased. These are mixed findings. On the one hand, it is good that the rate of sprawl has slowed, but on the other hand, for those who eschew population growth as irrelevant in sprawl, these findings contradict their dismissiveness.

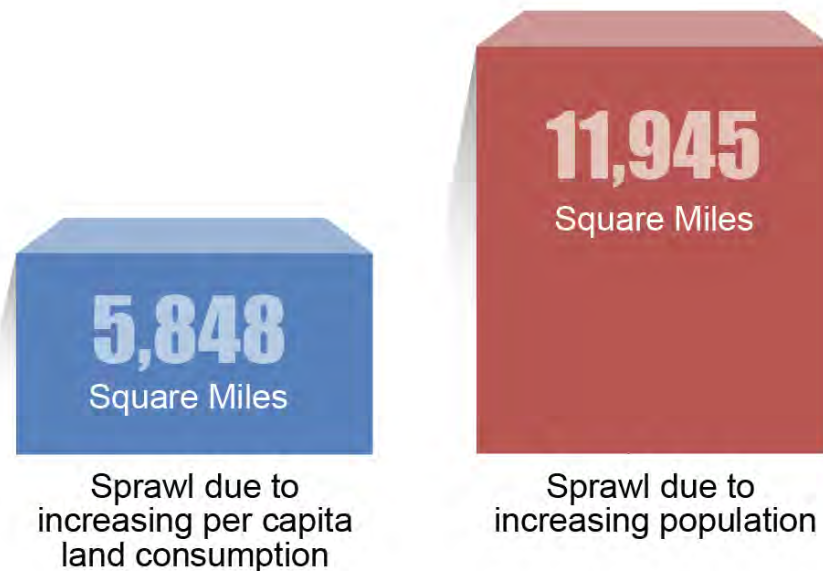


**Figure 54. Recent Sprawl Factors (Increasing Population and Increasing Per Capita Land Consumption) in 49 States, 2002-2017**

*Sources:* Analysis of Developed Land estimates from NRCS National Resources Inventory, 2017; population estimates for 2002 and 2017 for each American county and state from U.S. Census Bureau population estimates.

**Description:** Approximately 33 percent of the sprawl in America’s towns and cities was related to increasing per capita land consumption. Approximately 67 percent of the sprawl was related to population growth.

**Figure 55** shows that, between 2002 and 2017, population growth accounted for 11,945 square miles of sprawl, compared to 5,848 square miles related to Per Capita Sprawl or rising land consumption per capita.



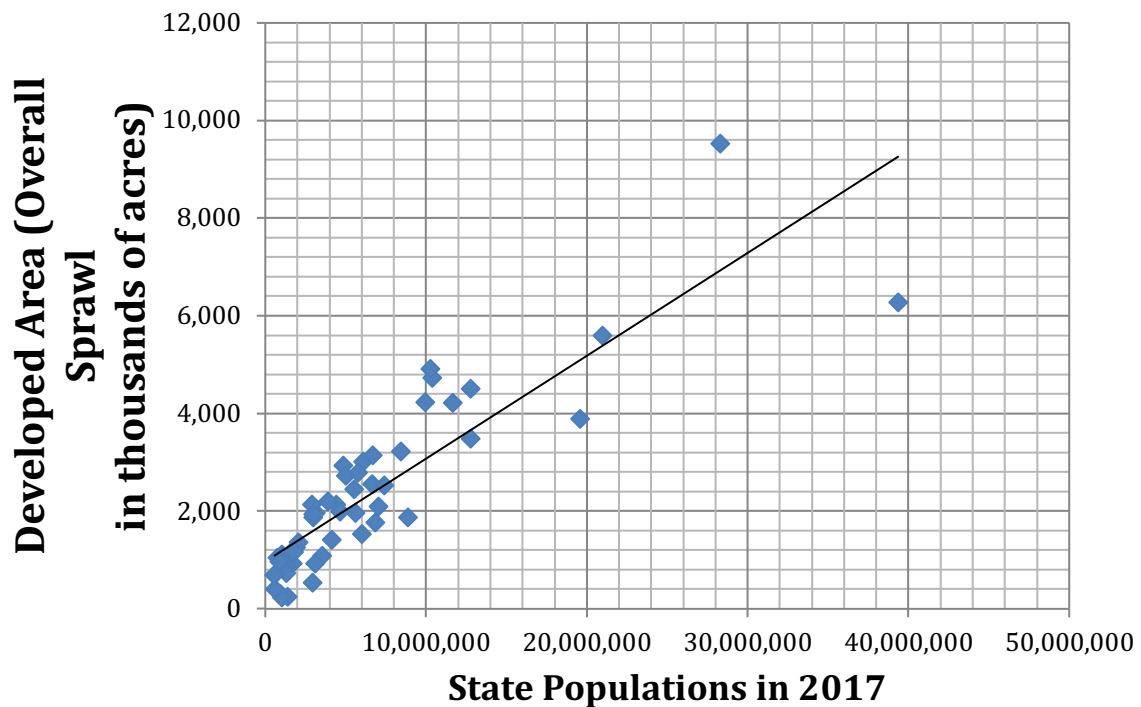
**Figure 55. Rural Land Lost to Per Capita Sprawl vs. Population Growth in 49 States, 2002-2017**

### 3.5 Scatter Plots of Total Population and Total Development

Another useful way to examine the relationships between the factors in sprawl is by using scatter plot analysis. **Figure 56** is a scatter plot for the 49 states in our study that examines the relationship between each state’s population size in 2017 on the x-axis (horizontal axis) and its area of developed land (i.e., cumulative sprawl) on the y-axis (vertical axis). The scatter plot has a “best fit” line that depicts the linear relationship between the data points.

The left-to-right, upward-sloping “best fit” line for **Figure 56** indicates that there is a positive relationship between population size and overall cumulative area of developed land (Overall Sprawl). States with larger populations are also those where more land has been developed cumulatively over time to accommodate the diverse land use needs of that population, which

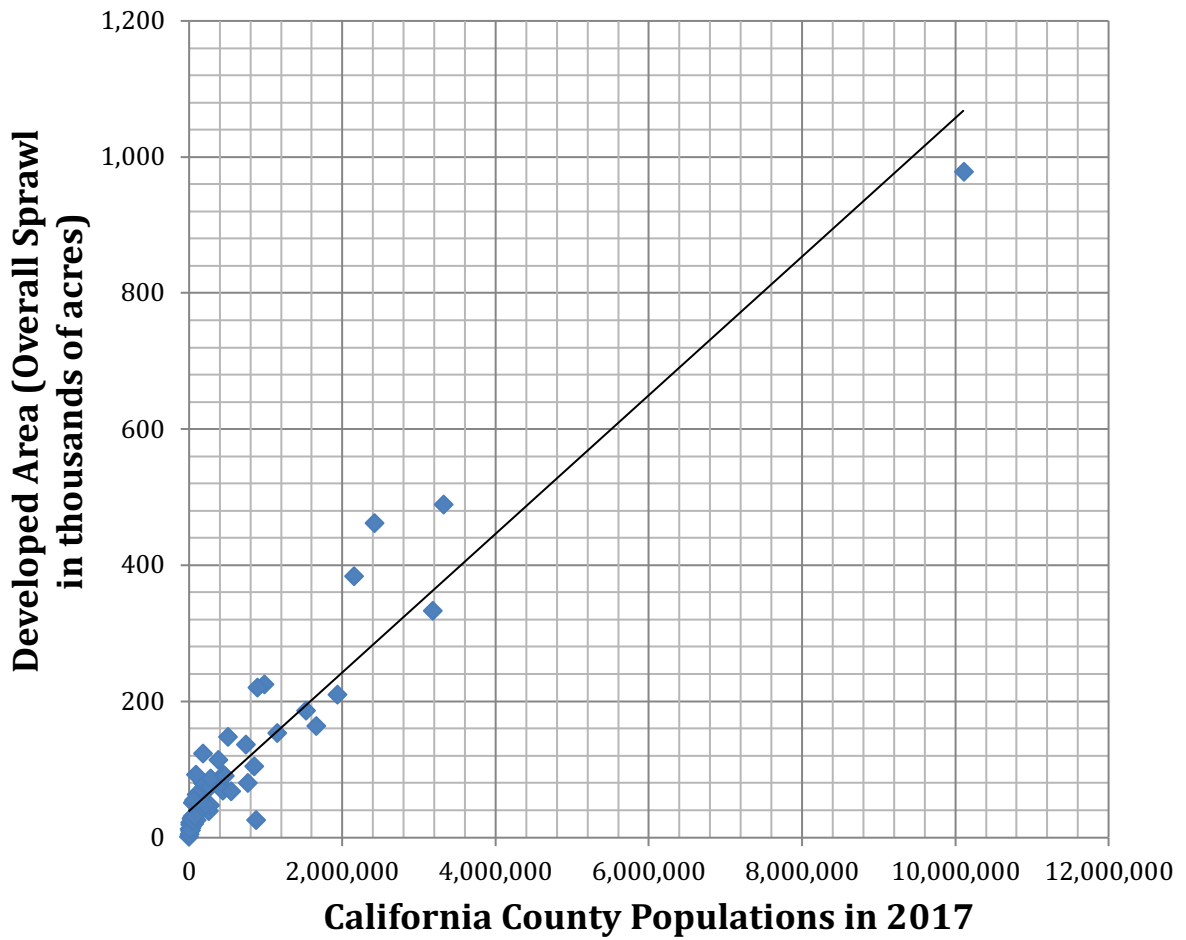
encompass far more than residential land for housing only. Perhaps these results are unsurprising, but if population size and sprawl were unrelated, as some have always maintained, the trend line would be flat or negative (sloping downward toward the right instead of upward). While this scatter plot alone does not prove that population causes sprawl, it does strongly suggest and reinforce the hypothesis that the two are closely correlated.



**Figure 56. Scatter Plot of Population Size vs. Cumulative Developed Area in 49 States, 2017**  
*Sources:* Census Bureau state population estimates and National Resources Inventory (2017)

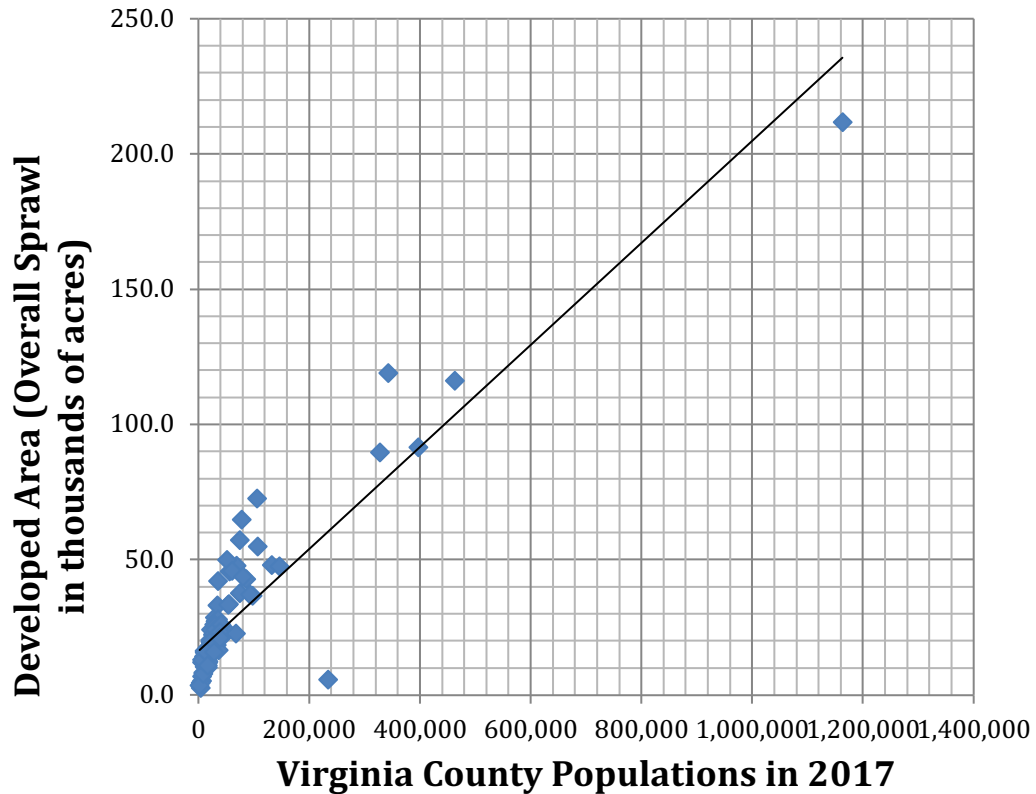
We prepared similar graphs for each of the 49 states in the study, which are shared in Appendix D. Here, for the purposes of illustration, we present just two of them, for California (**Figure 57**) and Virginia (**Figure 58**).

**Figure 57. Scatter Plot of Population Size vs. Cumulative Developed Area in**



**California Counties, 2017**

*Sources:* Census Bureau population estimates for California counties and NRI (2017)



**Figure 58. Scatter Plot of Population Size vs. Cumulative Developed Area in Virginia Counties, 2017**

*Sources:* Census Bureau population estimates for Virginia counties and NRI (2017)

We also used a common statistical test to measure how closely population size is correlated with the area of developed land (cumulative sprawl) in the 49 states. Correlation coefficients are widely employed in the natural and social sciences to measure how strong a relationship is between two variables.<sup>104</sup> In this case, one variable is population size and the other variable is the “footprint” (area of developed land) that population size imposes on a given state.

In general, correlation coefficients are used to find how strong a relationship is between data. The various formulas render an “r-value” between -1 and 1, where:

- 1 indicates a strong positive relationship.
- -1 indicates a strong negative relationship.
- A result of zero indicates no relationship at all.

<sup>104</sup> Statistics How To: Correlation Coefficient. Available online at: <https://www.statisticshowto.com/probability-and-statistics/correlation-coefficient-formula/#definition>.

Applying this statistical tool to the data (values) used for the 49 states in **Figure 55**, the correlation coefficient is **0.87**, indicating a very strong statistical relationship between population size and developed land area (sprawl). For California, the corresponding correlation coefficient is even stronger than the national-level one, at **0.95** (for the dataset used to generate **Figure 57**), while for Virginia, it's **0.91** (**Figure 58**). We also developed correlation coefficients for all 50 states in our study, shown in **Table 21**.

**Table 21. Correlation Coefficients Measuring Strength of Relationship between Population Size and Developed Land Area (Cumulative Sprawl) for 49 States, 2017**

| State       | Correlation Coefficient (R-value) | State          | Correlation Coefficient (R-value) | State          | Correlation Coefficient (R-value) |
|-------------|-----------------------------------|----------------|-----------------------------------|----------------|-----------------------------------|
| Alabama     | <b>0.97</b>                       | Maine          | <b>0.84</b>                       | Oklahoma       | <b>0.96</b>                       |
| Arizona     | <b>0.96</b>                       | Maryland       | <b>0.93</b>                       | Oregon         | <b>0.81</b>                       |
| Arkansas    | <b>0.96</b>                       | Massachusetts  | <b>0.82</b>                       | Pennsylvania   | <b>0.75</b>                       |
| California  | <b>0.95</b>                       | Michigan       | <b>0.95</b>                       | Rhode Island   | <b>0.92</b>                       |
| Colorado    | <b>0.90</b>                       | Minnesota      | <b>0.91</b>                       | South Carolina | <b>0.94</b>                       |
| Connecticut | <b>0.99</b>                       | Mississippi    | <b>0.95</b>                       | South Dakota   | <b>0.85</b>                       |
| Delaware    | <b>0.88</b>                       | Missouri       | <b>0.95</b>                       | Tennessee      | <b>0.98</b>                       |
| Florida     | <b>0.85</b>                       | Montana        | <b>0.93</b>                       | Texas          | <b>0.95</b>                       |
| Georgia     | <b>0.94</b>                       | Nebraska       | <b>0.94</b>                       | Utah           | <b>0.97</b>                       |
| Hawaii      | <b>0.68</b>                       | Nevada         | <b>0.93</b>                       | Vermont        | <b>0.81</b>                       |
| Idaho       | <b>0.92</b>                       | New Hampshire  | <b>0.98</b>                       | Virginia       | <b>0.91</b>                       |
| Illinois    | <b>0.94</b>                       | New Jersey     | <b>0.49</b>                       | Washington     | <b>0.92</b>                       |
| Indiana     | <b>0.97</b>                       | New Mexico     | <b>0.88</b>                       | West Virginia  | <b>0.93</b>                       |
| Iowa        | <b>0.96</b>                       | New York       | <b>0.42</b>                       | Wisconsin      | <b>0.80</b>                       |
| Kansas      | <b>0.95</b>                       | North Carolina | <b>0.95</b>                       | Wyoming        | <b>0.58</b>                       |
| Kentucky    | <b>0.94</b>                       | North Dakota   | <b>0.87</b>                       |                |                                   |
| Louisiana   | <b>0.85</b>                       | Ohio           | <b>0.95</b>                       |                |                                   |

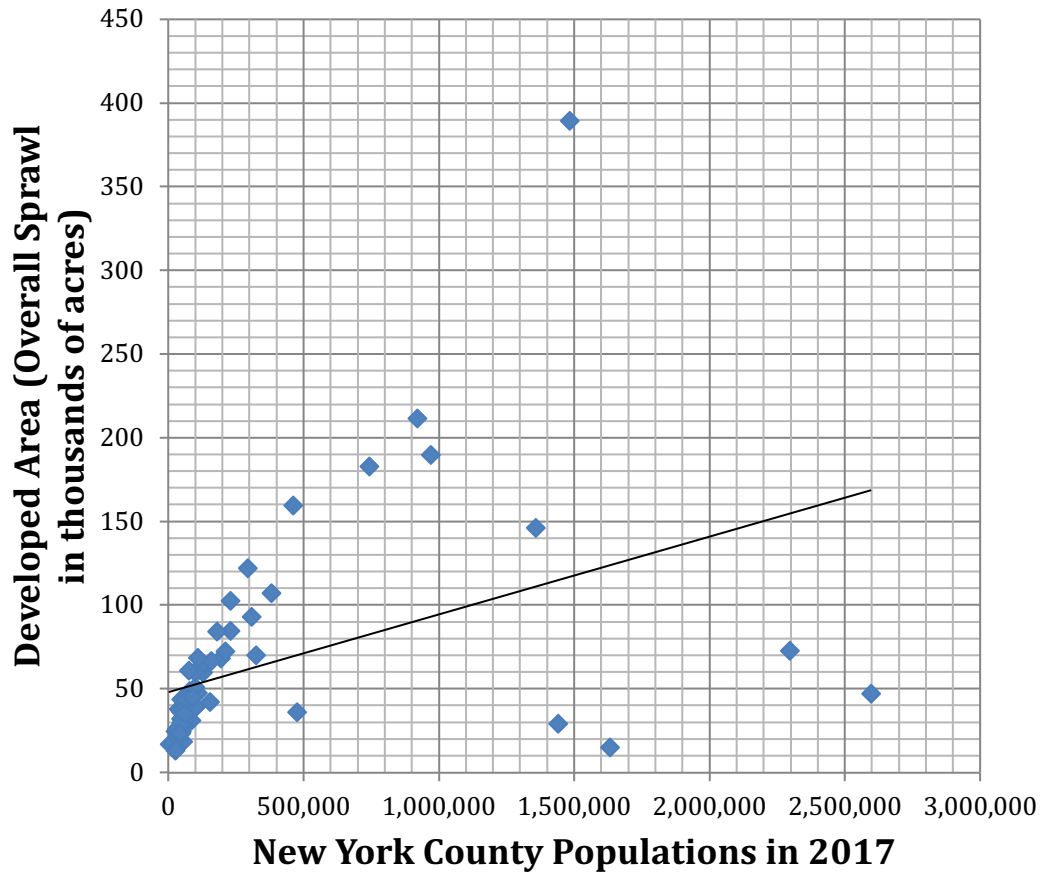
Note: **Very strong association**; **strong association**; **moderate association**

While there is some variation between states, in all but 3 of the 49, there is a “strong” (r-value  $> 0.6$ ) (one state) or “very strong” (r-value  $> 0.8$ ) (45 states) statistical relationship (high correlation coefficient expressed as r-value)<sup>105</sup> between population growth and sprawl. The three outliers are the neighboring states of New Jersey and New York and the low-density, low population, resource-rich Rocky Mountain state of Wyoming. New Jersey’s and New York’s r-values of 0.49 and 0.42 are rated as a “moderate association” between population size and cumulative sprawl. Wyoming has an r-value of 0.58 and also shows a “moderate association.”

New York is a special case, virtually in a category by itself, because of the distortion caused by the extreme population density in high-rise and skyscraper-dense New York City. Kings County, which includes the borough of Brooklyn, has the lowest per capita land use (high population density) of any county in the country, at 0.018 acre/person, or 56 persons/acre, which equals approximately 35,550 persons per square mile. This is less than one-tenth of the average per capita land use for the State of New York (0.20 acre/person in 2017). In contrast, Suffolk County, which includes the outer part of Long Island, including the affluent communities of The Hamptons, Manorville, Montauk, and Westhampton Beach; it contains a large population (1.5 million in 2017) at a relatively low population density. The scatter plot for New York State including all of its counties is shown in **Figure 59**, with the outliers clearly visible.

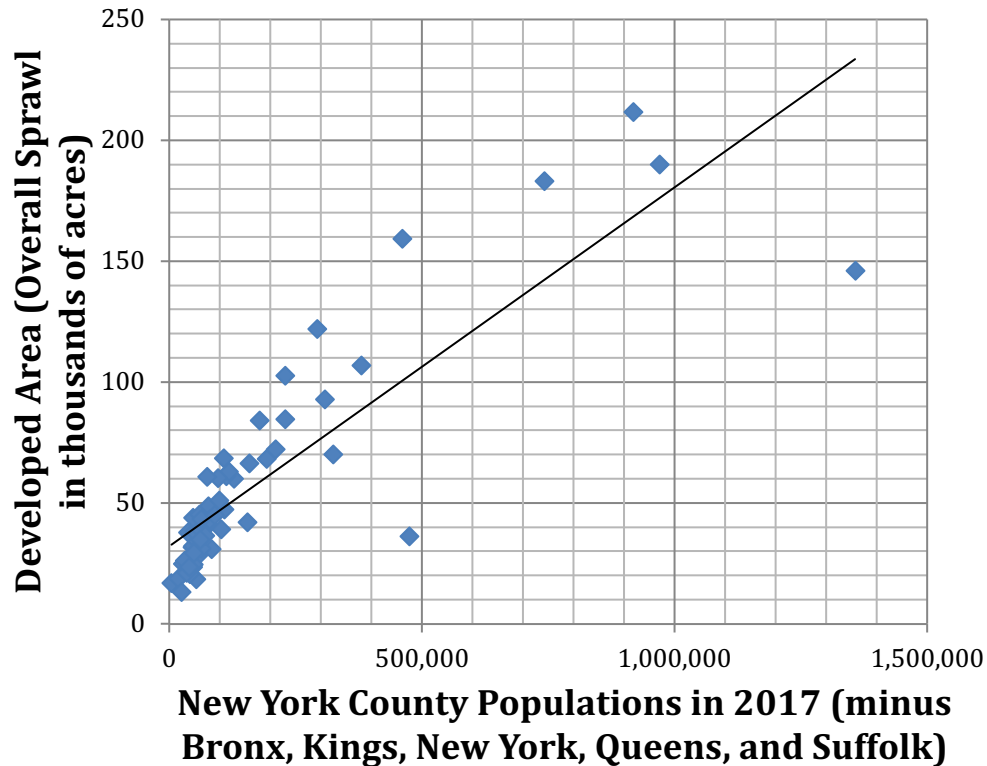
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<sup>105</sup> Boston University School of Public Health. The Correlation Coefficient. Accessed online at: <https://sphweb.bumc.bu.edu/otlt/MPH-Modules/PH717-QuantCore/PH717-Module9-Correlation-Regression/PH717-Module9-Correlation-Regression4.html>.



**Figure 59. Scatter Plot of Population Size vs. Cumulative Developed Area in New York Counties, 2017**

*Sources:* Census Bureau population estimates for New York counties and NRI (2017)  
 If the anomalies of low-density Suffolk County and the ultra-high-density New York City counties of Bronx, Kings, New York, and Queens were removed from the scatter plot (still leaving 57 of the 62 counties in the state), New York State r-value would be 0.86 and its scatter plot would look like this instead (**Figure 60**):

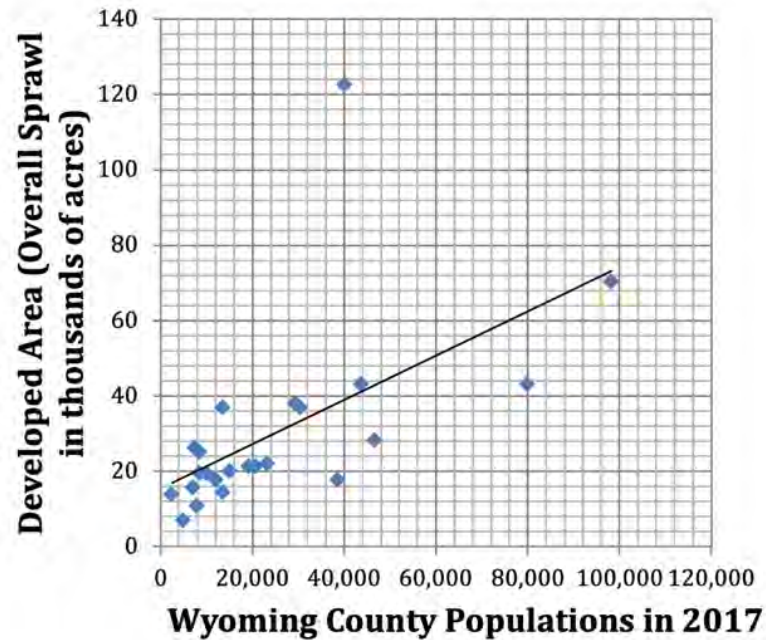


**Figure 60. Scatter Plot of Population Size vs. Cumulative Developed Area in New York Counties, Minus Anomalies (Bronx, Kings, New York, Queens, Suffolk), 2017**

*Sources:* Census Bureau population estimates for New York counties and NRI (2017)

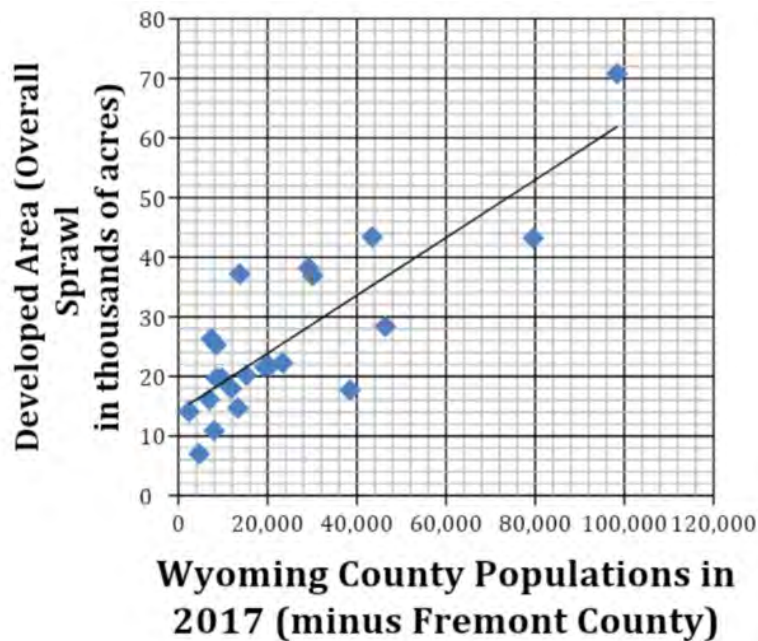
In Wyoming, a single county – Fremont – is a statistical outlier, with a moderately high population but an extremely high level of developed land according to the NRI. Fremont County has almost twice as much developed land as any other county in the state. We are uncertain as to why. It is the second-largest county by land area in Wyoming, and more than half of its land base is federally owned, including nearly 672,000 acres of protected land (such as congressionally designated national wilderness areas).<sup>106</sup> In any event, Fremont County is why the entire state of Wyoming is only rated as having a “moderate association” between population and sprawl. **Figure 61** shows Wyoming with all of its counties included, while **Figure 62** removes Fremont County from the scatter plot.

<sup>106</sup> Fremont County DRAFT Natural Resource Management Plan. Available online at: [https://cms9files.revize.com/fremontwy//Commission/Opportunities/FremontCounty\\_NRMP\\_PublicCommentDRAFT\\_07.16.2021.pdf](https://cms9files.revize.com/fremontwy//Commission/Opportunities/FremontCounty_NRMP_PublicCommentDRAFT_07.16.2021.pdf)



**Figure 61. Scatter Plot of Population Size vs. Cumulative Developed Area in Wyoming, 2017**

*Sources:* Census Bureau population estimates for Wyoming counties and NRI (2017)



**Figure 62. Scatter Plot of Population Size vs. Cumulative Developed Area in Wyoming Counties, Minus Anomaly (Fremont), 2017**

*Sources:* Census Bureau population estimates for Wyoming counties and NRI (2017)

The data values of the scatter plot in **Figure 62** have an r-value of 0.83.

### 3.6 Trends

From 1982 to 2017 the most significant factor contributing to Overall Sprawl in the 49 states in our study was the addition of 93 million new residents. Like each of the existing residents, each of these new residents – each and every one without exception – needed rural lands developed to accommodate the facilities and amenities associated with a modern lifestyle we have all come to expect and demand: housing; transportation and utilities infrastructure; commercial, institutional, and industrial land uses; resource extraction and waste disposal sites; and so forth.

Massive quantities of asphalt, concrete, rebar, steel, aluminum, gravel, lumber, glass, and other paving, structural, and building elements manufactured from raw materials gouged from the ground replaced soils and green plants on the Earth’s surface. On average, each new resident’s development “footprint” covered and claimed almost half an acre (0.47 acre) of rural land or open space, all of which was natural habitat or farmland until its conversion. In aggregate, all of this development imposed by 93 million more Americans sprawled across nearly 44 million acres (69,561 square miles) of the rural landscape.



**Figure 63. Coastal North Carolina has been subjected to intense development pressure in recent decades (kayaker at mouth of Neuse River in Pamlico Sound)**

In our previous studies, we had observed and documented a trend toward reduced sprawl rates, and more of that sprawl being related to population growth. This study also bears out that

long-term trend. **Table 22** shows the annual rate of sprawl from 1982 to 2002 and from 2002 to 2017 and the percentage of that sprawl related to population growth. While the annual rate of sprawl – the square miles of rural lands devoured by development every year – dropped considerably, from 2,985 to 1,186 (a 60% decline), the share of that sprawl associated with population growth rose from 57 percent to 67 percent. Nowadays, about two-thirds of all U.S. sprawl is related to population growth.

**Table 22. National Sprawl Trends (49 states)**

| Time Period  | Annual Sprawl Rate (square miles) | % Sprawl from Population Growth |
|--------------|-----------------------------------|---------------------------------|
| 1982 to 2002 | 2,985                             | 57%                             |
| 2002 to 2017 | 1,186                             | 67%                             |



**Figure 64. Idaho has become a magnet for population growth and sprawl over the last decade, many of its new residents fleeing overpopulation and dystopia in California**

## 4. CONCLUSIONS AND POLICY IMPLICATIONS

### 4.1 Conclusions

**At both the state level and the national level there is a broad correlation between population size and sprawl: generally, the larger a city, county, or state's population, the larger the land area it will sprawl across.**

This is shown clearly in **Figure 55**, a simple scatter plot of the 49 states' cumulative populations and developed land areas in 2017. 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 those prone to wishful thinking and fairy tales that there is an insignificant connection between population size or growth rates and environmental consequences.

**Sprawl continues to devour rural landscapes around the country at a rapid rate.**

Although the pace of sprawl peaked in the late 1990s and early 2000s, our most recent data since 2002 show that it continues to devour open space at a rate of almost 1,200 square miles acres per year (768,000 acres) or 3.3 square miles (2,112 acres) every day. In all likelihood, this rate has accelerated with the gradual waning of the 2008-2009 Great Recession, though we don't yet have the data to confirm this hypothesis. Even at this reduced rate, sprawl would continue to convert an additional 12,000 square miles of America's valuable rural lands, open space, agricultural land and wildlife habitat into pavement and buildings every decade. By 2050, another 36,000 square miles (23 million acres) of America's rural lands will have been paved or covered with subdivisions; hotels; industrial, office and theme parks; schools; and commercial strips, a great and permanent loss to American agricultural lands, wildlife habitat, natural heritage, quality of life, and environmental sustainability.

Smart growth efforts, higher gasoline prices, fiscal and budgetary constraints (limiting new road-building, for example), the increasing popularity of denser city living (pre-Covid pandemic) and its cultural amenities, and the recession-inducing mortgage meltdown in 2008 may have all played roles in slowing America's rate of sprawl late in the first decade of this century and into the second decade. The extent to which any of these and still other unforeseen factors and events – such as the coronavirus (COVID-19) pandemic of 2020-2021 – may affect the rate of sprawl in the coming decades is unknown and unpredictable. It may well be that concerns about high density residential living in the face of disease pandemics could increase sprawl pressures by raising the preference of consumers for lower-density suburban neighborhoods.

As an April 2020 article in *The New York Times* indicated:

“The pandemic has been particularly devastating to America’s biggest cities, as the virus has found fertile ground in the density that is otherwise prized. And it comes as the country’s major urban centers were already losing their appeal for many Americans, as skyrocketing rents and changes in the labor market have pushed the country’s youngest adults to suburbs and smaller cities often far from the coasts.”<sup>107</sup>

The article quoted Brookings Institution demographer William Frey, who noted that even before the coronavirus pandemic, “millennials and older members of Generation Z were already increasingly choosing smaller metro areas like Tucson, Ariz.; Raleigh, N.C.; and Columbus, Ohio.... Also growing were exurbs and newer suburbs outside large cities. ‘There was a dispersion from larger metros to smaller metros, from urban cores to suburbs and exurbs.’”

A January 2021 article at *ZeroHedge* cited a report by the company U-Haul documenting internal U.S. migration patterns based on one-way rentals of U-Haul trucks. The article concluded that: “We have never seen such a sudden mass exodus away from major cities in modern American history.”<sup>108</sup>

In any case, as more and more of Rural and Small Town America succumb to development – chipped away and clogged with roads, vehicles, people, facilities and infrastructure – at some point it will not be possible to maintain rapid rates of sprawl simply because other critical land uses – e.g., high-value crop and pastureland; national and state parks, forests, and wildlife refuges; mines; watersheds and reservoir buffer zones; utility corridors; U.S. military bases and arsenals – will represent a larger and larger fraction of the remaining undeveloped land.

For example, in Southern California, near the boundary between Orange County and San Diego County, 125,000-acre (195 square mile) Marine Corps Base Camp Pendleton permanently separates and puts a stop to the southward-spreading sprawl of the Los Angeles metro region to the north from the northward-spreading sprawl of the San Diego region to the south. Camp Pendleton may be unique among American military installations for possessing a large road

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<sup>107</sup> Sabrina Tavernise and Sarah Mervosh. 2020. America’s Biggest Cities Were Already Losing Their Allure. What Happens Next? *New York Times*. April 19. Accessed online on 4/22/2020 at: <https://www.nytimes.com/2020/04/19/us/coronavirus-moving-city-future.html>. The article also quoted Harvard University economics professor Ed Glaeser, author of *Triumph of the City*, who said: “It feels like it’s back to smallpox, back to cholera. Cities were killing fields for centuries because of contagious disease.” Glaeser observed that the life expectancy of a baby born in a city in 1900 was seven years less than one born in a rural area, but that that gap had disappeared by the 1920s with advances in modern water supply and sewage systems.

<sup>108</sup> Tyler Durden. 2021. “U-Haul Reveals 2020 Migration Trends as Pandemic and Taxes Take Toll.” *ZeroHedge*. January 9. Accessed online at: <https://www.zerohedge.com/personal-finance/u-haul-reveals-2020-migration-trends-pandemic-and-taxes-take-toll>.

sign that boasts that it is “preserving precious resources”, or more specifically, given its location, “Preserving California’s Precious Resources” (**Figure 65**).



**Figure 65. Marine Corps Base Camp Pendleton Sign Facing Traffic on Interstate 5**

In some regions, such as the Southwest, water scarcity and climate change (still hotter, dryer temperatures) may also restrict dispersed, never-ending development, forcing higher and higher densities, like them or not.

**The role of population growth in driving sprawl in the United States has increased over the past half century.**

In our previous national-level study on sprawl, *Vanishing Open Spaces: Population Growth and Sprawl in America*, published in 2014, among other analyses, we examined urban sprawl in the largest 100 U.S. Census Bureau-delineated Urbanized Areas (UAs) in the United States in two separate time periods: from 1970 to 1990, and from 2000 to 2010.<sup>109</sup> From 1970 to 1990, population growth was related to 51 percent of aggregate sprawl over that 20-year time period in the 100 largest UAs. In contrast, by the more recent 2000 to 2010 time period, the role of the population factor had increased to 70 percent.<sup>110</sup>

The present study further corroborates our hypothesis that the role of population growth in forcing continuing urban sprawl has increased over the past 50 years. Looking at the different time periods of the NRI and the NRI’s entirely different methodology of measuring Developed Land over time from the Census Bureau’s methodology for measuring changes in Urbanized

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<sup>109</sup> Leon Kolankiewicz, Roy Beck, and Anne Manetas. 2014. *Vanishing Open Spaces: Population Growth and Sprawl in America*. Arlington, VA: NumbersUSA. Available online at: <https://www.numbersusa.com/sites/default/files/public/assets/resources/files/vanishing-open-spaces-study.pdf>.

<sup>110</sup> Ibid. Table 13. P. 62.

Area, over time, we still derive similar results, which gives us confidence in the robustness of our findings.

If the entire 35-year period (1982-2017) of NRI data is examined in its entirety, population growth accounts for 60 percent (41,140 square miles) of the 68,560 square miles of sprawl. However, if the period is divided into two parts, 1982 to 2002, and 2002 to 2017, here is what we find:

- From 1982 to 2002, population growth accounted for **57 percent** (34,256 square miles) of the 59,690 square miles of sprawl during this earlier period.
- From 2002 to 2017, population growth accounted for **67 percent** (11,945 square miles) of the 17,793 square miles of sprawl during this more recent period.

As we have stated earlier, the NRI data analyzed in this study strongly suggest that the rate of new sprawl has slowed over the past decade or decade and a half, likely due to a variety of factors. We await the release of the Census Bureau's Urbanized Area delineations associated with the 2020 Census, probably in 2022, to see whether the newest UA data confirm an apparent slowdown in the rate of urban sprawl.

In our 2014 *Vanishing Open Spaces* study, looking at Census Bureau UA data for the 1970-1990 and 2000-2010, no slowdown in the rate of sprawl in the 100 largest UAs nationally had yet been observed, but this was probably too early to have detected adverse housing market effects or fallout from the 2008-2009 Great Recession. Indeed, our study showed that the sprawl rate actually increased slightly (13%) from the 1970-1990 period to the 2000-2010 period, as indicated in the bullets below.

- From 1970 to 1990, the rate of sprawl measured in square miles per decade in the 100 largest UAs was **7,273**.
- From 2000 to 2010, the rate of sprawl measured in square miles per decade in the 100 largest UAs was **8,243**.

**Attempts to concentrate and direct development into confined, denser areas are not enough to offset the pressures from population growth.**

According to the World Bank, cities grow along three margins or axes to accommodate their increasing populations: horizontal spread, infill development, and vertical layering (**Figure 66**).<sup>111</sup> Horizontal spread, or urban sprawl, is when growth of the urbanized (built-up) area extends beyond the margin of a city's existing built-up area and pushes out into the countryside. Infill development is the closing or elimination of gaps between existing structures in the

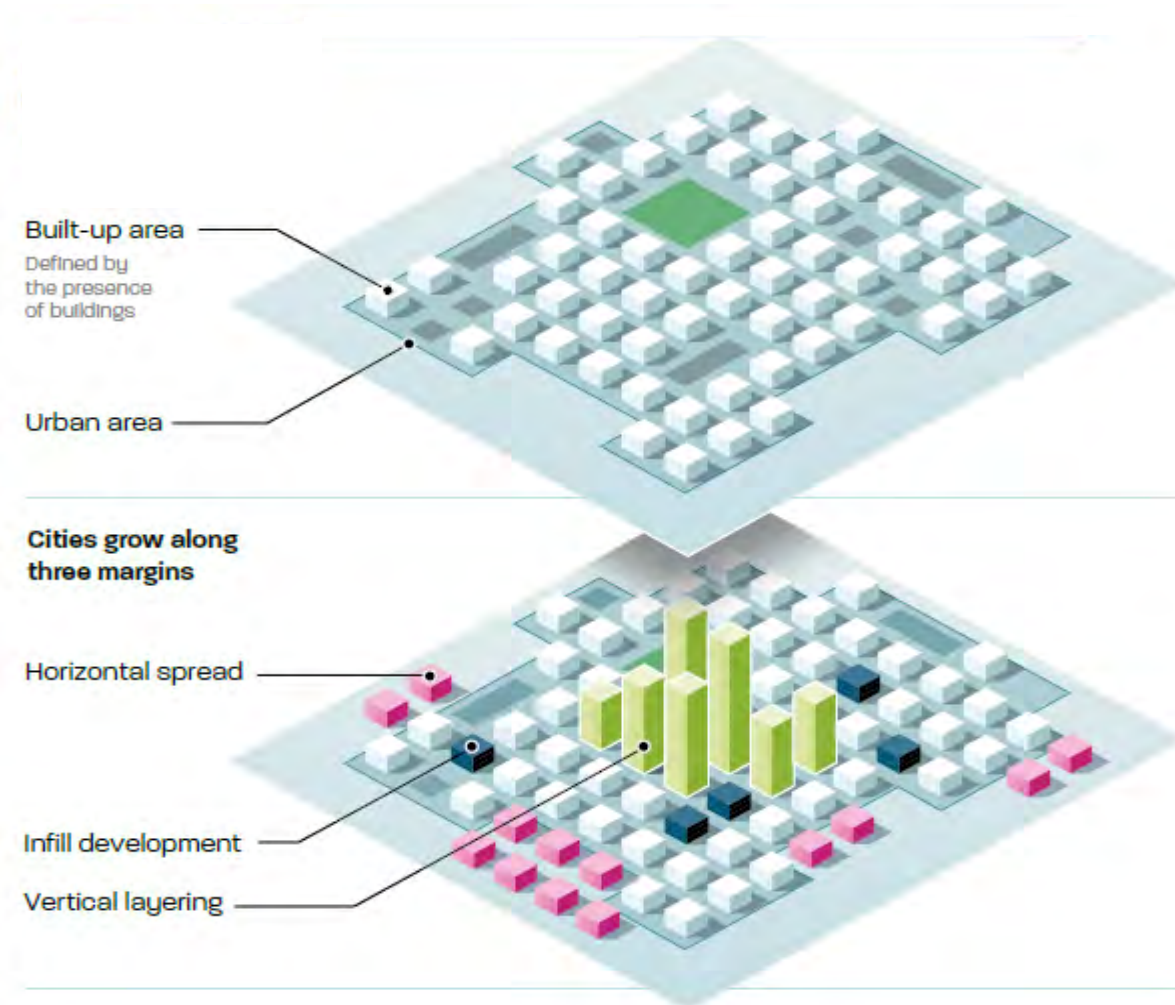
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<sup>111</sup> Lall, S. V., M. Lebrand, H. Park, D. Sturm, and A. J. Venables. 2021. *Pancakes to Pyramids: City Form to Promote Sustainable Growth*. Washington, DC: World Bank.

existing built-up area. Vertical layering is “raising the skyline of the existing built-up area.” These choices are sometimes summarized as “building out” (the first) or “building up” (the second and third). Under the first option, overall population density of the urbanized or developed area may stay the same or decrease. Under the second two options, population density increases.

**Figure 66. Three Types of Physical Growth in Cities**

*Source: World Bank (Lall et al., 2021)*



One of the more controversial aspects of President Joe Biden’s proposed infrastructure plan would explicitly promote infill development and vertical layering. The plan aims to increase population densities in suburbia by limiting “exclusionary” single-family zoning and allowing for the construction of affordable housing (**Figure 67**) – that is, placing apartment and condo buildings in the middle of detached single-family dwellings.<sup>112</sup>

<sup>112</sup> Romina Ruiz-Goiriena. 2021. Biden’s infrastructure plan calls for cities to limit single-family zoning and instead build affordable housing. USA Today. April 14. Accessed online at:

Similarly, an important objective of the Smart Growth movement is to preserve open space, farmland, natural beauty, wildlife habitat, and critical environmental areas outside urban boundaries by preventing declining population density. Thus, places where population density increases should be hailed as success stories. Between 2000 and 2010 in **Arizona**, there were four out of six Urbanized Areas (i.e., two-thirds of all Arizona UAs) whose density increased – in other words, their per capita land consumption decreased. However, three out of four of these UAs still experienced appreciable sprawl.



**Figure 67. The Solution to Sprawl: building upward instead of outward?**

No Urbanized Area in the country has come close to **Portland, Oregon** in the lengths it has gone to curb sprawl, and perhaps no city in America better exemplifies the shortcoming and limitations of the Smart Growth approach as Portland.

Despite being lauded for its urban growth boundary (UGB), extensive light rail infrastructure, and high-density mixed-use developments, even Portland has been unable to contain its own sprawl. Between 2000 and 2010, the Portland UA decreased its per capita land consumption by five percent from 0.19 acre per person to 0.18 acre per person, one of the highest average urban population densities in the country.

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<https://www.usatoday.com/in-depth/news/nation/2021/04/14/zoning-biden-infrastructure-bill-would-curb-single-family-housing/7097434002/>.

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However, despite its modest gain in population density (reduction in per capita land consumption) over the decade, the Portland UA still sprawled outward an additional 50.4 square miles between 2000 and 2010. The addition of 266,760 people during the decade was more than enough to wipe out the increased population density and cause the urbanized area to swell by an additional 11 percent. 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 and along the scenic Willamette Valley 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 percent from 2000 to 2010, and which has quickly become the second largest city in Oregon.

Of the 192 Urbanized Areas in the United States which experienced a decline in per capita land area during the 2000 to 2010 decade, **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. Its per capita land consumption decreased by 0.003 acre. At the same time, the population grew by over 300,000 people, causing the Raleigh UA to become more densely populated. But despite Raleigh's drop in per capita acreage, its 63 percent increase in population caused it to sprawl out across an additional 198.5 square miles in those 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 Texas, the **Houston UA** reduced its per capita land use (increased its density) slightly from 0.2169 acre/person in 2000 to 0.2149 acre/person in 2010, a decrease of almost one percent. According to the conventional wisdom espoused by Smart Growthers, because density increased, by definition there was no sprawl on the Houston UA periphery from 2000 to 2010, yet the region still lost over 365 square miles of open space during this period.

In the first of our nationwide sprawl studies almost two decades ago, 18 of the 100 largest Urbanized Areas in the U.S. 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.**

Throughout the country, 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 2012 study by Eben Fodor and Associates, **cities experiencing rapid population growth had higher rates of unemployment** and were more affected by the 2007-2008 recession than were cities with slower growth rates.<sup>113</sup>

This can be seen in urbanized areas like **Pittsburgh (Figure 68)**, 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 had an unemployment level well below the national rate in 2009 after the Great Recession. 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.



**Figure 68. Downtown Pittsburgh, Pennsylvania, at the confluence of the Monongahela (right) and Allegheny Rivers (left), which combine to form the Ohio River at The Point**

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<sup>113</sup> Eben Fodor. 2012. Relationship Between Growth and Prosperity in the 100 Largest U.S. Metropolitan Areas. *Economic Development Quarterly*. Available at: <http://edq.sagepub.com/content/26/3/220>.

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 29<sup>th</sup> 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 contaminated "brownfields", driving residents to build outward into the suburbs. Cases like Pittsburgh highlight the necessity of a two-pronged approach to addressing overall sprawl: both population growth – undertaken primarily at a national level, not a local one – and per capita consumption sprawl.

Recognition by scholars that population growth is a major (not the only) driver of urban land expansion and sprawl is sharply at odds with the way most news media and anti-sprawl activists in the United States have tended to portray the causes of sprawl. The news media and anti-sprawl activists appear to have accepted that rapid, unending U.S. population growth on the order of 20 to 30 or more million new residents per decade is a given and a *fait accompli*.

Thus, since they want to convince Americans that something can still be done to halt or slow sprawl substantially in spite of never-ending U.S. population growth, they tend to downplay or minimize population's importance as a causal factor in sprawl. In their efforts to publicize sprawl to the American public and enlist support for anti-sprawl measures – e.g., "smart growth" policies, higher residential densities, multifamily housing (apartments and condominiums), mixed land uses and zoning, and infill that eliminates existing urban open space (such as golf courses) – they reserve their criticism for "low-density sprawl," essentially giving a pass to other new development on the urban periphery, as long as it is not low-density, even though it still permanently devours rural land and open space.

**If current population trends are allowed to continue, America will experience vast amounts of sprawl over the next half century.**

If demographic and immigration trends in the United States continue as officially projected by demographers at the U.S. Census Bureau, the nation will experience considerable conversion of rural lands to urbanized lands in the coming decades. In other words, considerable sprawl. Population projections by other professional demographers at other respected institutions such as the Pew Center and the Population Reference Bureau differ in their details but not in their essence.

By 2060, less than 40 years from now, the U.S. Census Bureau projects that the U.S. population will have grown from 330+ million to 404 million Americans.<sup>114</sup> This is an increase of approximately 70 million over four decades, or about 18 million per decade. It should be noted that this amount of growth per decade represents a significant slowdown in the decadal growth rate since 1950, seven decades ago. (In the 1930s, the decade of the Great Depression, the U.S. population grew by only 9 million, but just two decades later, during the 1950s Baby Boom era, it grew by 29 million.) For us as conservationists, 18 million new residents straining our natural resources and environment every decade is a still long way from the crucial goal of U.S. population stabilization, but given the almost hysterical reaction of pundits, politicians, and the news media to U.S. population growth of “only” 23 million in the 2010 to 2020 decade, we suspect that the American establishment will do everything in its power – such as promoting incentives to raise the birth rate, or more easily accomplished, raising the immigration rate – to postpone or try to prevent the inevitable: an eventual cessation, one way or another, of U.S. population growth. Many on both the political Left and political Right who are diametrically opposed on most issues can still unite to argue for perpetual U.S. population growth. In 2020, left-leaning journalist and *Vox* co-founder Matthew Yglesias authored a book pushing one billion Americans as a national goal, and some of its more favorable reviews came from “conservatives.” (One wonders what they hope to “conserve” of America with three times the population weighing it down.)

In 2017, each American resident on average, “consumed” or had a “footprint” of 0.358 acre of Developed Land. That is slightly more than one-third of an acre per person. If we assume that each average resident of the 70 million new Americans projected between now and 2060 were to consume only 0.25 acre per person – a substantial improvement in lowering the per capita footprint or impact – this would mean that “only” 17.5 million acres (27,340 square miles) of additional rural lands – farmlands and wildlife habitat – would be converted to developed land. This is an area of rural land larger than all of West Virginia and slightly smaller than South Carolina. For us, and for the pursuit of environmental sustainability, this is simply unacceptable.

Also, let us remember that the world does not end – and sprawl would not peak – in 2060 if current population growth and immigration levels are encouraged. Population growth and concomitant sprawl would continue well beyond 2060 with no end in sight.

## 4.2 Policy Implications

In order for American 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

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<sup>114</sup> Jonathan Vespa, Lauren Medina, and David M. Armstrong. 2020. Demographic Turning Points for the United States: Population Projections for 2020 to 2060. U.S. Census Bureau. Available online at: <https://www.census.gov/content/dam/Census/library/publications/2020/demo/p25-1144.pdf>.

original studies in 2000 and 2001, and using the same analysis of U.S. National Resource Conservation Service data that we have used for years, this study provides further evidence of the necessity for such a two-pronged approach in order to effectively combat sprawl in the United States. Furthermore this study found that the role of population growth in contributing to Overall Sprawl has significantly increased from the 1970s to the present. 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 growth 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 a third of recent sprawl was caused by a complicated array of zoning laws, infrastructure subsidies, other incentives, and complex socioeconomic forces. Efforts to make cities and communities more space-efficient and livable are certainly advisable, but they largely ignore the main concern that sprawl is eating away at the remaining undeveloped lands of the United States.

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 the rapidly growing states such as Texas, Florida, Arizona, Georgia, North Carolina, and Utah.

As noted above, based on the results of our study and projections by reputable demographers, urban sprawl will swallow up perhaps another 30,000 square miles of American farmland, forest, grasslands, and wildlife habitat by 2060 if current population growth trends continue.

#### **4.2.1 Local Influence on Sprawl**

Local policy makers truly trying to curb sprawl in American cities have a number of policy actions and instruments at their disposal. While most local officials see population growth as an indicator of the economic 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, author of *Better Not Bigger*, challenged this very notion in his 2012 study "Relationship between Growth and Prosperity in 100 Largest U.S. Metropolitan Areas."<sup>115</sup>

Fodor's study found that rapidly expanding metropolitan areas did not hold up well in terms of standard economic indicators such as unemployment rates, per capita income, and poverty

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<sup>115</sup> Eben Fodor. Op. cit. See footnote #106.

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, industries, and development. Often these subsidies are born unfairly by existing residents, who see their property taxes rise and are stuck footing the bill for sprawling subdivisions, highways, new schools, water and wastewater treatment, and energy grids ever farther from the urban core.

Many cities have overly complicated or restrictive 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. Sprawl in the Sunbelt is of particular concern because its growth puts added strain on already scarce 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 suggested by Harvard economist Edward Glaeser, author of *Triumph of the City*, 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 reduce the size of population booms in areas not suited to handle large populations.

The U.S. Environmental Protection Agency (EPA) has a website devoted to Smart Growth at: <https://www.epa.gov/smartgrowth>. It contains a number of practical resources for planners, activists, developers, and local officials to help promote smart growth, which EPA defines as: “a range of development and conservation strategies that help protect our health and natural environment and make our communities more attractive, economically stronger, and more socially diverse.”

The EPA Smart Growth website lists the 10 principles of smart growth developed in 1996 by the Smart Growth Network, an alliance of environmental, affordable housing, real estate and development, historic preservation, public health, government, and other groups. The ten principles of Smart Growth are:

- Mix land uses
- Take advantage of compact building design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty, and critical environmental areas



- Strengthen and direct development toward existing communities
- Provide a variety of transportation choices
- Make development decisions predictable, fair, and cost effective
- Encourage community and stakeholder collaboration in development decisions

According to the NGO Smart Growth America and Tucson, Arizona’s then-mayor, downtown Tucson has been undergoing a revival that embraces smart growth principles.<sup>116</sup> In 2013, then-mayor Jonathan Rothshield said that a 3.9-mile streetcar line called the Sun Link, connecting the University of Arizona, 4th Avenue Business District, Congress Avenue Shopping and Entertainment District and the Mercado District had served as a catalyst, “transformed our community and our downtown” (**Figure 69**). According to Rothshield, people and businesses were moving back to the downtown core after decades of departing it for the city’s expanding periphery. Between 2008 and 2013, nearly 50 new restaurants, cafes, and bars opened or expanded downtown. These businesses alone injected more than \$12 million in private investment capital into the area. Overall, during that period, 141 new businesses opened up downtown, attracting an estimated \$800 in total private and public investment.



**Figure 69. Sun Link Streetcar in Downtown Tucson**

*Credit: City of Tucson*

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<sup>116</sup> Craig Chester. 2013. Mayor Jonathan Rothshield on the revival of downtown Tucson, AZ. October 28. Smart Growth America: Making Neighborhoods Great Together. Accessed online April 26, 2020 at: <http://old.smartgrowthamerica.org/2013/10/28/mayor-jonathan-rothschild-on-the-revival-of-downtown-tucson-az/>

Up in the Pacific Northwest, the organization Oregon Smart Growth (OSG) belongs to the national NGO Smart Growth America. It advocates for “development that’s economically, socially, and environmentally sustainable.”<sup>117</sup> OSG aims to “bring hands-on experience and expertise on how Oregon can create more jobs and housing opportunities, increase property values and provide sustainable economic growth.” In 2018, OSG partnered with the Up For Growth national coalition and the economics, finance and planning research outfit ECONorthwest to produce the report “Housing Underproduction in Oregon”.<sup>118</sup>

This publication explains that:

At its most basic level, Smart Growth achieves higher density than current housing development patterns and therefore requires less land to accommodate the same number of units. In Oregon, Smart Growth requires just 18% of the land area required for the More of the Same scenario. Utilizing less land means higher economic efficiency for local jurisdiction service delivery, as well as environmental benefits such as storm water remediation and undisturbed room for forestry and farming.

This study also asserted that from 2000 to 2015, the deficit of housing units in Oregon grew to approximately 155,000, about nine percent of the total 2015 housing stock. It referenced a “housing and homelessness crisis playing out across the state” and averred that implementing Smart Growth strategies would be a significant step towards resolving this crisis, as well as reducing vehicular pollution, increasing the gross state product (GSP), and boosting income and property taxes.

Under what this report calls “More of the Same Growth” pattern, 67 percent of new residential development in Oregon would be low-density (detached single-family homes), 28 percent would be medium-density or “missing middle housing” (e.g., duplexes, townhouses, triplexes, fourplexes, bungalow courts), and just four percent would be high-density (e.g., condominiums, apartments, towers, high-rises). Under OSG’s proposed Smart Growth pattern, in contrast, just eight percent of new development would be low-density, while 54 percent would be medium-density, and fully 38 percent would be high-density (**Figure 70**). The net result would be much higher population density overall within the state’s Urbanized/Developed Areas.

Examining the results of a 2019 public opinion poll of 1,000 likely Oregon voters conducted for our January 2020 Oregon sprawl study,<sup>119</sup> a near-majority of Oregonians appeared to

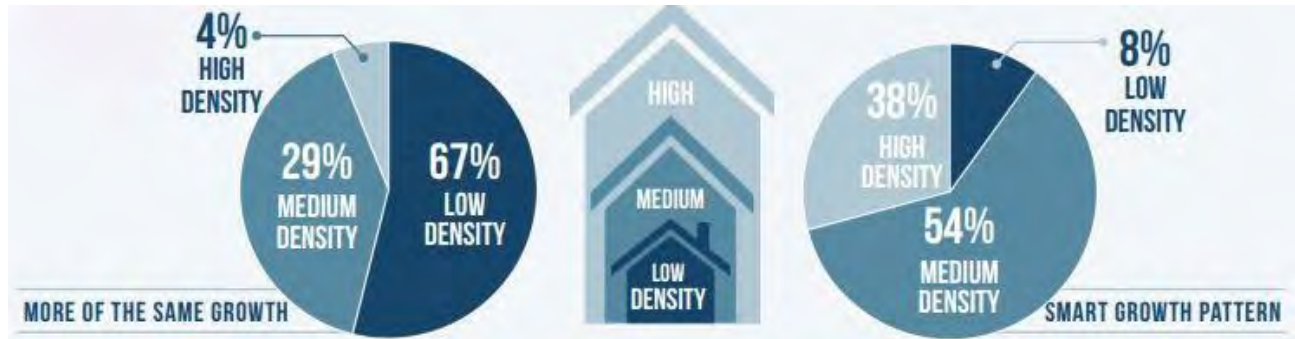
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<sup>117</sup> Oregon Smart Growth website at <https://www.oregonsmartgrowth.org/>.

<sup>118</sup> “Housing Underproduction in Oregon: Economic, Fiscal, and Environmental Impacts of Enabling Transit-Oriented Smart Growth to Address Oregon’s Housing Affordability Challenge.” Available online at: <https://www.upforgrowth.org/sites/default/files/2018-10/UFGHousingUnderproductionInOregon.pdf>.

<sup>119</sup> Pulse Opinion Research. 2019. Oregon Survey of 1,000 Likely Voters. Conducted October 29-29, 2019. Most questions had a Margin of Sampling Error of +/- 3 percentage points with a 95% level of

support measures to encourage higher residential population density in the state’s already developed (urbanized) areas as a means of combating urban sprawl:



**Figure 70. More of the Same Growth versus Smart Growth Patterns in Oregon**

*Source:* “Housing Underproduction in Oregon”; footnote 111

13. One way to handle continued population growth without losing as much open space in Oregon is to change zoning and other regulations so that more residents live in apartment and condo buildings instead of single-family houses. Do you strongly favor, somewhat favor, somewhat oppose or strongly oppose this kind of change?

- 16% Strongly favor
- 32% Somewhat favor
- 23% Somewhat oppose
- 18% Strongly oppose
- 11% Not sure

Asked whether they favored or opposed zoning and other regulations so that more residents would live in apartment and condo buildings instead of single-family houses, 48% of Oregonians “strongly” or “somewhat” favor such measures, while 41% “somewhat” or “strongly” opposed them, with 11 percent unsure.

In recent years, a growing pro-development citizens’ movement in urban centers has emerged and been making waves. This so-called YIMBY movement (for “Yes In My Backyard”, in explicit contrast to the NIMBY or “Not In My Backyard” movement) began in San Francisco in the early 2010s, fueled by millennials fed up with astronomical housing prices that effectively priced them out of living in the city. According to *The Guardian*, YIMBY advocates see themselves as progressive housing activists welcoming higher density and rents and mortgages affordable to the middle class, while their detractors denounce them as dupes

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confidence. This survey appeared in Appendix E in NumbersUSA’s 2020 study of sprawl in Oregon: Leon Kolankiewicz, Roy Beck, and Eric Ruark. 2020. Population Growth & Sprawl in Oregon. Arlington, VA: NumbersUSA. January. Available online at: [https://www.numbersusa.org/sites/default/files/public/assets/resources/files/Oregon\\_Sprawl.pdf](https://www.numbersusa.org/sites/default/files/public/assets/resources/files/Oregon_Sprawl.pdf).

for luxury developers, contributing to the gentrification of urban centers.<sup>120</sup> In San Francisco, NIMBYs have clashed with Hispanic organizations over housing developments proposed for the low-income, traditionally Hispanic Mission District.

In the authors' view, in general, Smart Growth principles and strategies should be pursued for the sake of environmental sustainability and neighborhood livability in any case, regardless of the amount of population growth that is occurring. From the findings of this study however, as well as recent experience around the country, it is quite evident that Smart Growth alone will not stop urban sprawl from devouring the countryside. Physicist and famed population activist Dr. Albert Bartlett wrote that: "smart growth will destroy the environment, but it will do it in a sensitive way." The authors would phrase this idea somewhat differently: smart growth is necessary but not sufficient to save the environment and open spaces from incessant sprawl.

In early 2020, the coronavirus pandemic (Covid-19, caused by the SARS-CoV-2 virus) – threw a curve ball into all of these long-term trends and emerging considerations, and proponents of higher urban densities were put on the defensive. As the headline of an article in the *Los Angeles Times* expressed it: "Building dense cities was California's cure for the housing crisis. Then came coronavirus."<sup>121</sup> Half of respondees in our May 2020 public opinion agreed that the pandemic made dense city living less attractive than it had been previously:

17\* As a result of the coronavirus pandemic, does living in a more densely populated area appear more attractive, less attractive or has it not made much difference?

14% More attractive  
50% Less attractive  
32% It has not made much difference  
3% Not sure

On top of the pandemic, in the summer of 2020, and continuing to the present time, a crime wave began surging through many American cities in the wake of widespread civil unrest, protests, and riots in response to the widely publicized death of a suspect in police custody in Minneapolis and the decision of many elected city officials around the country to "defund" police departments, curtail proactive policing, and decline to prosecute many misdemeanors and other low-level, non-violent crimes. A sharp increase in both violent and property crimes

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<sup>120</sup> Erin McCormick. 2017. Rise of the yimbys: the angry millennials with a radical housing solution. *The Guardian*. October 2. Retrieved online April 26, 2020 at: <https://www.theguardian.com/cities/2017/oct/02/rise-of-the-yimbys-angry-millennials-radical-housing-solution>.

<sup>121</sup> Liam Dillon. 2020. Building dense cities was California's cure for the housing crisis. Then came coronavirus. *Los Angeles Times*. April 26. Accessed online April 26, 2020 at: <https://www.latimes.com/homeless-housing/story/2020-04-26/coronavirus-density-cities-urbanization-housing-climate-change>.

has also prompted thousands of urban residents to decamp for the suburbs or even for other states and regions in search of lower crime rates and higher personal security.

Our late May 2020 public opinion survey<sup>122</sup> of 1,500 likely American voters came in the midst of the coronavirus pandemic but preceded the urban violence in the summer of 2020. One of the questions asked about promoting higher urban population density as a means of combating sprawl while still accommodating population growth, of “having our cake and eating it too,” in a sense. The national response was very similar to results when the same question was posed in a 2019 survey in Oregon and 2020 survey in Arizona:

14\* One way to handle continued population growth without losing as much natural habitat and farmland would be to increase population density by changing zoning and other regulations so more residents live in apartments and condo buildings instead of single-family houses. Do you strongly favor, somewhat favor, somewhat oppose or strongly oppose this kind of change?

|                     |                     |
|---------------------|---------------------|
| 16% Strongly favor  | 17% Strongly oppose |
| 32% Somewhat favor  | 12% Not sure        |
| 24% Somewhat oppose |                     |

A near-majority (48%) supported governments promoting measures to increase urban population density as a means of minimizing sprawl, while a strong plurality (41%) opposed such measures. This suggests that there is likely to be substantial opposition to Biden Administration efforts to increase suburban densities through infill, high rises, and affordable housing.

#### 4.2.2 National Influence of Population Growth

Beyond the short term, local government officials across the country supportive of growth control and management can hope only to slow population growth in their jurisdictions if national population continues to increase by some 2.0 to 3.0 million additional residents each year. These 20-30 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. Each one of these added millions will seek a home in some community or another, thereby adding to that community’s physical footprint on an ever more cluttered landscape.

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:

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<sup>122</sup> Op. cit. Footnote #16.

- Native fertility: At approximately 1.6 to 1.7 births per female, the total fertility rate (TFR) of the United States 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 – half a century.
- 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 and since the “Great Recession” has remained above replacement level and well above native fertility, until very recently.

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 intake and settlement of immigrants from one-quarter million in the 1950s and 1960s to averaging over a million since 1990, fluctuating between one million and nearly two million, once net illegal immigration is included. Until the numerical level of national immigration is lowered, even the best local plans and political commitment will be unable to stop sprawl. Yet the Biden administration has been moving in the opposite direction, opening the southern border to any from around the world who wish to enter and signaling that it wants to pass one or more amnesties as well as increase legal immigration rates.

Any serious efforts to halt the loss of open space, farmland, and wildlife habitat in the United States 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 Democratic Congresswoman Barbara Jordan. That would move annual immigration back to around the level that was the norm as recently as the 1980s.

A poll of 1,500 America’s likely voters in May 2020 by Pulse Opinion Research found that reducing immigration had the support of about half the U.S. population when linked with the goal of slowing down U.S. population growth (see Appendix G for the full survey questions and results). Approximately an equal number of respondents favored maintaining or increasing the immigration level and associated population growth. Thus, Americans are more or less evenly divided over immigration levels and population growth.

12\* Census data shows that since 1970, annual immigration has tripled and is now the cause of nearly all long-term population growth. Should the federal government reduce annual immigration to slow down population growth, keep immigration and population growth at the current level, or increase annual immigration and population growth?

- 47% Reduce annual immigration to slow down population growth
- 33% Keep annual immigration and population growth at the current level
- 12% Increase annual immigration and population growth
- 8% Not sure

The 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, sprawl, and environmental degradation indefinitely.<sup>123</sup>

That is why another federal commission recommended far greater reductions in immigration. In 1996, the President's Council on Sustainable Development 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 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."<sup>124</sup>

It is important to underscore that the additional sprawl that occurs because of high immigration levels has nothing to do with the caliber of immigrants as people or individuals but 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 or from another continent.

In our 2003 national-level study, we devoted several pages to our findings on ways in which an Urbanized Area's population growth from immigrants would have either a larger or smaller 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

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<sup>123</sup> Camarota, Steve, *Projecting Immigration's Impact on the Size and Age Structure of the 21st Century American Population*, Center for Immigration Studies, December 2012

<sup>124</sup> 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.

presumably prefer central cities to suburbs was false. The majority of immigrants now live in suburbs where the sprawl occurs.<sup>125</sup> 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.

In parts of the country, regions are undergoing rapid population growth from internal migration of U.S. residents and citizens fleeing from cities and states heavily affected by immigration. This then, is a secondary or indirect effect of mass immigration. This is especially true in the West and the long-running exodus of native-born working-class and middle-class Californians out of that state and into the neighboring states of Nevada, Arizona, Oregon, Washington, Idaho, and beyond.

Arizona's and Oregon's population growth, for example, is heavily influenced by immigration in a major way not involving the actual immigrants settling in these states. Because their next-door neighbor California has experienced so many negative quality-of-life and economic consequences from its massive, immigration-fueled population growth, for decades Arizona and Oregon has received a large number of California "refugees" fleeing the effects of this overpopulation. This has been going on for a long time: as far back as the 1970s, Oregon's governor Tom McCall pleaded: "Don't Californicate Oregon!" His plea went unheeded. Because nearly all of California's population growth is due to immigration, much of the California migration into Arizona and Oregon (and other states) must be considered yet another consequence of the quadrupled level of annual immigration rates since 1970.

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 or more 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 irrigated agricultural lands or irreplaceable natural habitats.

This is not a sustainable path, and it is not one we believe that fully informed Americans would voluntarily choose.

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<sup>125</sup> 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: <https://www.brookings.edu/research/immigrants-in-2010-metropolitan-americaa-decade-of-change/>

# 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.

**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.

**Migration** – Permanent movement or resettlement of an individual or group from one place to another. Internal or domestic migration is from one city, state, or region to another within the United States. International or foreign migration is when foreign-born individuals or groups move permanently, with or without permission (legally or illegally), into the United States from a foreign country. In-migration refers to migration into the country from a foreign location or into a state from another state. Emigration, or out-migration is the opposite.

**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.

**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 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.

**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. In the 2010 to 2020 decade, U.S. population growth was approximately 23 million, a notable decline from the previous two decades, but still far from “population stabilization” (zero population growth).

**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 and developers 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 2017 the 48 coterminous states and Hawaii had a combined population of 323,550,933 residents and approximately 115,726,400 developed acres. Thus, per capita developed land use for all purposes was around 0.358 acre (slightly more than a third of an acre) per resident.

The land used per person is the total developed or urbanized 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 county or state can be simply expressed or “factored” into the product of the Population of the county or 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), county, 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  $\Delta t$  (e.g., a year or a decade), the population grows by an increment  $\Delta P$  and the per capita land use changes by  $\Delta a$ , the total urbanized land area grows by  $\Delta A$ , expressed as:

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

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  $\Delta t$  yields:

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

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 an urbanized land area or developed area of a country (viz., 100 percent  $\times \Delta A/A$ ) is the sum of the

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

$$(4) \quad \text{Overall percentage land area growth} = \text{Overall percentage population growth} + \text{Overall percentage per capita growth}$$

In essence, this apportioning 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:

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

The same form applies for per capita land use:

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

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):

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

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:

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

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

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

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

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

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

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

$$(12) \quad g_P + g_a = g_A$$

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:

$$(13) \quad \ln(\text{final population} / \text{initial population}) + \ln(\text{final per capita land area} / \text{initial per capita land area}) = \ln(\text{final total land area} / \text{initial total land area})$$

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 the United States (49 states) from 1982 to 2017, this formula would appear as:

$$(14) \quad \ln(323,550,993 \text{ residents} / 230,580,652 \text{ residents}) + \ln(0.358 \text{ acre per resident} / 0.312 \text{ acre per resident}) = \ln(115,726,400 \text{ acres} / 71,847,500 \text{ acres})$$

Computing the ratios yields:

$$(15) \quad \ln(1.403) + \ln(1.148) = \ln(1.611)$$

$$0.339 + 0.138 = 0.477$$

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 0.54381:

$$(16) \quad \frac{0.339}{0.477} + \frac{0.138}{0.477} = \frac{0.477}{0.477}$$

Performing these divisions yields:

$$(17) \quad 0.71 + 0.29 = 1.0$$

Thus, we note that in the case of the 49 states of the USA (all except Alaska) from 1982 to 2015, the share of sprawl due to population growth was 71 percent [100 percent x (0.339 / 0.477)], while declining density (i.e., an increase in land area per capita) accounted for 29 percent [100 percent x (0.138 / 0.477)]. Note that the sum of both percentages equals 100 percent.

In the main body of this report we modify this gross state-wide percentage of sprawl related to population growth by using a county-by-county weighting approach. This approach accounts for the sprawl that occurs in each county and applies a proportionately greater weight to those counties with greater amounts of sprawl. In essence, sprawl in counties around Flagstaff, Arizona for example, should not be attributed to population growth in counties around Phoenix or Tucson.

In this method, the amount of sprawl related to population growth in each county is summed for all of the counties each of the states. This sum or aggregate is then divided by the total amount of sprawl in the state. Using this procedure, by way of example, 92 percent of the sprawl in Texas between 1982 and 2015 was shown to be related to population growth, which the authors believe is a more accurate rendering of population growth's role than 113 percent, which

exaggerates population's role, and implies that all sprawl (and then some) in Texas during that period was related to population growth, which was not the case.

However, the opposite can also occur. That is, hypothetically, the weighted average for a state can also be greater than the gross state-wide percentage.

This is best illustrated by the State of West Virginia (p. D-293 in Appendix D), where the population did not grow from 1982 to 2017, but actually fell by seven percent. Because there was no population growth – indeed there was population decline instead – by our own terminology and procedures, population growth cannot have been related to any sprawl at all in West Virginia in the 1982 to 2017 time period. All sprawl in the state must have been associated with growth in per capita land consumption (i.e., declining population density).

Indeed, this is what is shown on p. D-293. The 827.3 square miles of sprawl in West Virginia from 1982-2017 was all related to declining per capita land consumption, or what we call Per Capita Sprawl. The right-most column, labeled “% Sprawl Related to Population Growth” shows “0”, as it should according to our methodology.

However, it seems a bit absolutist or extreme to conclude that no sprawl at all in the state was related to population growth. How could this be, when individual county results for West Virginia show that population growth did account for some of their own sprawl?

For example, Berkeley County, WV sprawled by 83.4 square miles from 1982 to 2017, a 215% increase in the area of Developed Land. Its population also grew by 66,545, a 137% increase. Our calculations estimate that 75% of the sprawl in Berkeley County was due to population growth. However, if we examine West Virginia's counties only in the aggregate, these more “granular” results vanish, and that leads to an inaccurate and extreme conclusion that no sprawl at all in the entire state was related to population growth.

But if we add up the counties one by one, weighting them proportionately by how much sprawl and population growth occurred in each county individually, we can obtain a more accurate result for the state as a whole. This is shown in the bottom row of the table for West Virginia (p. D-293 in Appendix D), and indicates that approximately 18 percent of the sprawl (increase in area of Developed Land, or 827.3 square miles) in the state from 1982 to 2017 was related to population growth.

## Appendix D

### Individual State and County Data and Results, 1982-2017

*Sources:* NRCS, 2017 National Resources Inventory (2020); U.S. Census Bureau, county population estimates, 1982 & 2017

#### Alabama

| Alabama County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Autauga        | 32,036          | 55,390          | 23,354                  | 73                        | 18.0                                   | 32.9                                   | 23.3  | 83                         | 91                                    |
| Baldwin        | 82,331          | 212,521         | 130,190                 | 158                       | 55.1                                   | 123.8                                  | 107.3   | 125                        | 100                                   |
| Barbour        | 24,777          | 25,157          | 380                     | 2                         | 24.1                                   | 30.8                                   | 10.5  | 28                         | 6                                     |
| Bibb           | 16,020          | 22,550          | 6,530                   | 41                        | 9.6                                    | 21.9                                   | 19.2  | 128                        | 41                                    |
| Blount         | 36,355          | 57,787          | 21,432                  | 59                        | 20.9                                   | 48.8                                   | 43.6  | 133                        | 55                                    |
| Bullock        | 10,639          | 10,176          | -463                    | -4                        | 7.6                                    | 12.9                                   | 8.3   | 70                         | 0                                     |
| Butler         | 22,399          | 19,888          | -2,511                  | -11                       | 11.0                                   | 21.4                                   | 16.3  | 95                         | 0                                     |
| Calhoun        | 122,109         | 114,710         | -7,399                  | -6                        | 30.3                                   | 55.1                                   | 38.8  | 82                         | 0                                     |

| <b>Alabama County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Chambers              | 39,336                 | 33,707                 | -5,629                         | -14                              | 16.1  | 22.5  | 10.0   | 40                                | 0  |
| Cherokee              | 19,525                 | 25,805                 | 6,280                          | 32                               | 16.8  | 29.7  | 20.2   | 77                                | 49   |
| Chilton               | 30,361                 | 44,120                 | 13,759                         | 45                               | 13.2  | 32.2  | 29.7   | 144                               | 42   |
| Choctaw               | 16,367                 | 12,925                 | -3,442                         | -21                              | 16.0  | 22.8  | 10.6   | 43                                | 0  |
| Clarke                | 27,946                 | 24,063                 | -3,883                         | -14                              | 17.7  | 25.7  | 12.5   | 45                                | 0  |
| Clay                  | 13,765                 | 13,350                 | -415                           | -3                               | 9.5   | 13.8  | 6.7  | 45                                | 0  |
| Cleburne              | 12,876                 | 14,899                 | 2,023                          | 16                               | 7.5   | 11.7  | 6.6  | 56                                | 33   |
| Coffee                | 39,836                 | 51,853                 | 12,017                         | 30                               | 18.9  | 29.4  | 16.4   | 56                                | 60   |
| Colbert               | 54,069                 | 54,695                 | 626                            | 1                                | 23.6  | 40.0  | 25.6   | 69                                | 2  |
| Conecuh               | 15,526                 | 12,431                 | -3,095                         | -20                              | 10.6  | 15.3  | 7.3  | 44                                | 0  |
| Coosa                 | 11,330                 | 10,724                 | -606                           | -5                               | 9.5   | 18.7  | 14.4   | 97                                | 0  |
| Covington             | 36,777                 | 37,062                 | 285                            | 1                                | 28.5  | 39.2  | 16.7   | 38                                | 2  |

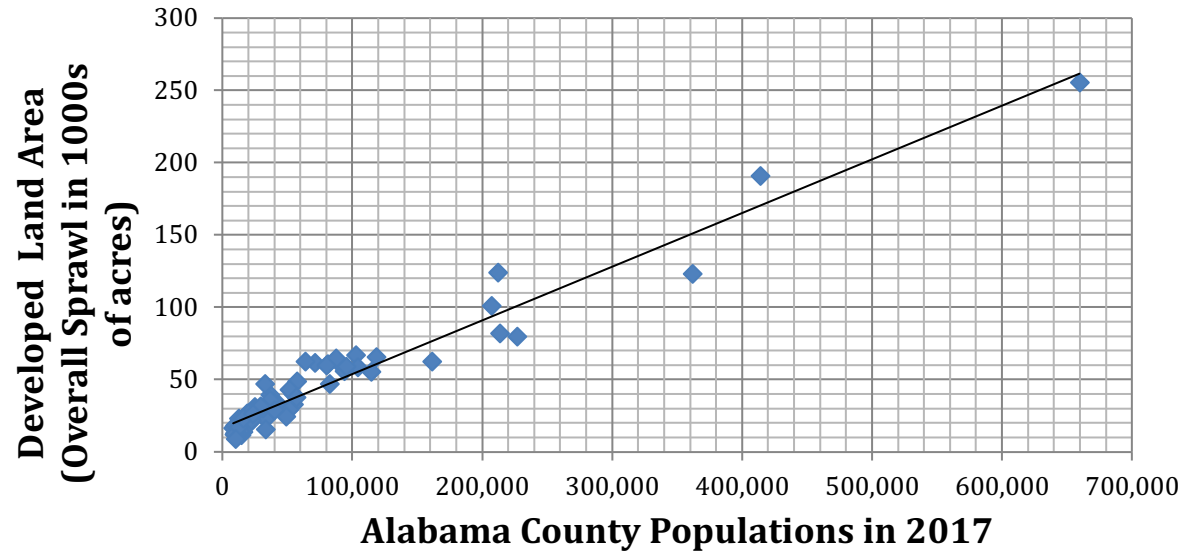
| <b>Alabama County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Crenshaw              | 13,998                 | 13,858                 | -140                           | -1                               | 8.9   | 16.2  | 11.4   | 82                                | 0  |
| Cullman               | 62,382                 | 82,867                 | 20,485                         | 33                               | 16.8  | 47.1  | 47.3   | 180                               | 28   |
| Dale                  | 48,500                 | 49,342                 | 842                            | 2                                | 15.0  | 24.3  | 14.5   | 62                                | 4  |
| Dallas                | 53,947                 | 39,238                 | -14,709                        | -27                              | 19.8  | 34.6  | 23.1   | 75                                | 0  |
| DeKalb                | 53,798                 | 71,437                 | 17,639                         | 33                               | 32.1  | 61.5  | 45.9   | 92                                | 44   |
| Elmore                | 44,343                 | 81,422                 | 37,079                         | 84                               | 33.7  | 60.5  | 41.9   | 80                                | 100  |
| Escambia              | 37,474                 | 36,993                 | -481                           | -1                               | 20.9  | 35.8  | 23.3   | 71                                | 0  |
| Etowah                | 102,524                | 103,007                | 483                            | 0                                | 41.8  | 67.0  | 39.4   | 60                                | 1  |
| Fayette               | 19,181                 | 16,466                 | -2,715                         | -14                              | 9.5   | 13.6  | 6.4  | 43                                | 0  |
| Franklin              | 28,255                 | 31,542                 | 3,287                          | 12                               | 20.0  | 30.2  | 15.9   | 51                                | 27   |
| Geneva                | 23,769                 | 26,385                 | 2,616                          | 11                               | 17.5  | 27.5  | 15.6   | 57                                | 23   |
| Greene                | 11,007                 | 8,310                  | -2,697                         | -25                              | 10.6  | 16.2  | 8.8  | 53                                | 0  |

| <b>Alabama County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Hale                  | 15,417                 | 14,801                 | -616                           | -4                               | 10.0  | 14.4  | 6.9  | 44                                | 0  |
| Henry                 | 15,219                 | 17,115                 | 1,896                          | 12                               | 12.0  | 17.2  | 8.1  | 43                                | 33   |
| Houston               | 77,072                 | 104,378                | 27,306                         | 35                               | 34.0  | 58.2  | 37.8   | 71                                | 56   |
| Jackson               | 51,292                 | 51,828                 | 536                            | 1                                | 22.9  | 43.1  | 31.6   | 88                                | 2  |
| Jefferson             | 662,404                | 659,599                | -2,805                         | 0                                | 166.5   | 255.5   | 139.1  | 53                                | 0  |
| Lamar                 | 16,485                 | 13,882                 | -2,603                         | -16                              | 14.8  | 21.5  | 10.5   | 45                                | 0  |
| Lauderdale            | 81,070                 | 92,564                 | 11,494                         | 14                               | 37.3  | 58.7  | 33.4   | 57                                | 29   |
| Lawrence              | 30,588                 | 33,063                 | 2,475                          | 8                                | 13.5  | 47.1  | 52.5   | 249                               | 6  |
| Lee                   | 79,001                 | 161,440                | 82,439                         | 104                              | 23.8  | 62.3  | 60.2   | 162                               | 74   |
| Limestone             | 46,429                 | 94,130                 | 47,701                         | 103                              | 23.4  | 55.9  | 50.8   | 139                               | 81   |
| Lowndes               | 12,811                 | 10,097                 | -2,714                         | -21                              | 9.7   | 18.1  | 13.1   | 87                                | 0  |
| Macon                 | 26,403                 | 18,793                 | -7,610                         | -29                              | 11.8  | 18.8  | 10.9   | 59                                | 0  |

| <b>Alabama County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Madison               | 202,737                | 361,762                | 159,025                        | 78                               | 47.5  | 123.2   | 118.3  | 159                               | 61   |
| Marengo               | 24,666                 | 19,396                 | -5,270                         | -21                              | 19.9  | 26.5  | 10.3   | 33                                | 0  |
| Marion                | 30,586                 | 29,792                 | -794                           | -3                               | 17.7  | 31.3  | 21.3   | 77                                | 0  |
| Marshall              | 66,869                 | 95,572                 | 28,703                         | 43                               | 30.2  | 58.7  | 44.5   | 94                                | 54   |
| Mobile                | 374,782                | 414,045                | 39,263                         | 10                               | 122.3   | 190.9   | 107.2  | 56                                | 22   |
| Monroe                | 22,628                 | 21,290                 | -1,338                         | -6                               | 15.1  | 20.0  | 7.7  | 32                                | 0  |
| Montgomery            | 200,094                | 227,265                | 27,171                         | 14                               | 56.2  | 79.6  | 36.6   | 42                                | 37   |
| Morgan                | 90,503                 | 118,918                | 28,415                         | 31                               | 33.1  | 65.4  | 50.5   | 98                                | 40   |
| Perry                 | 14,743                 | 9,302                  | -5,441                         | -37                              | 7.2   | 11.9  | 7.3  | 65                                | 0  |
| Pickens               | 21,697                 | 20,204                 | -1,493                         | -7                               | 16.8  | 26.7  | 15.5   | 59                                | 0  |
| Pike                  | 27,959                 | 33,349                 | 5,390                          | 19                               | 10.9  | 15.7  | 7.5  | 44                                | 48   |
| Randolph              | 20,245                 | 22,687                 | 2,442                          | 12                               | 10.4  | 21.6  | 17.5   | 108                               | 16   |

| Alabama County | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Russell        | 46,662           | 56,985           | 10,323                  | 22                        | 27.2                                   | 37.5                                   | 16.1  | 38                         | 62                                    |
| St. Clair      | 42,119           | 87,926           | 45,807                  | 109                       | 33.8                                   | 64.7                                   | 48.3  | 91                         | 100                                   |
| Shelby         | 70,960           | 213,633          | 142,673                 | 201                       | 26.1                                   | 81.8                                   | 87.0  | 213                        | 96                                    |
| Sumter         | 17,003           | 12,749           | -4,254                  | -25                       | 11.0                                   | 17.4                                   | 10.0  | 58                         | 0                                     |
| Talladega      | 74,734           | 80,142           | 5,408                   | 7                         | 31.1                                   | 59.8                                   | 44.8  | 92                         | 11                                    |
| Tallapoosa     | 38,429           | 40,613           | 2,184                   | 6                         | 19.1                                   | 28.9                                   | 15.3  | 51                         | 13                                    |
| Tuscaloosa     | 137,532          | 207,618          | 70,086                  | 51                        | 47.1                                   | 101.0                                  | 84.2  | 114                        | 54                                    |
| Walker         | 67,978           | 63,895           | -4,083                  | -6                        | 29.8                                   | 62.2                                   | 50.6  | 109                        | 0                                     |
| Washington     | 17,568           | 16,522           | -1,046                  | -6                        | 17.0                                   | 22.8                                   | 9.1   | 34                         | 0                                     |
| Wilcox         | 15,054           | 10,691           | -4,363                  | -29                       | 7.9                                    | 8.7                                    | 1.3   | 10                         | 0                                     |
| Winston        | 21,966           | 23,760           | 1,794                   | 8                         | 13.2                                   | 26.0                                   | 20.0  | 97                         | 12                                    |
| <b>Totals</b>  | <b>3,925,263</b> | <b>4,874,486</b> | <b>949,223</b>          | <b>24</b>                 | <b>1,641.4</b>                         | <b>2,936.2</b>                         | <b>2,023.1</b>                                    | <b>79</b>                  | <b>37</b>                             |

| Alabama County          | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Weighted Average</b> |                 |                 |                         |                           |  |  |   |                            | <b>38</b>                             |



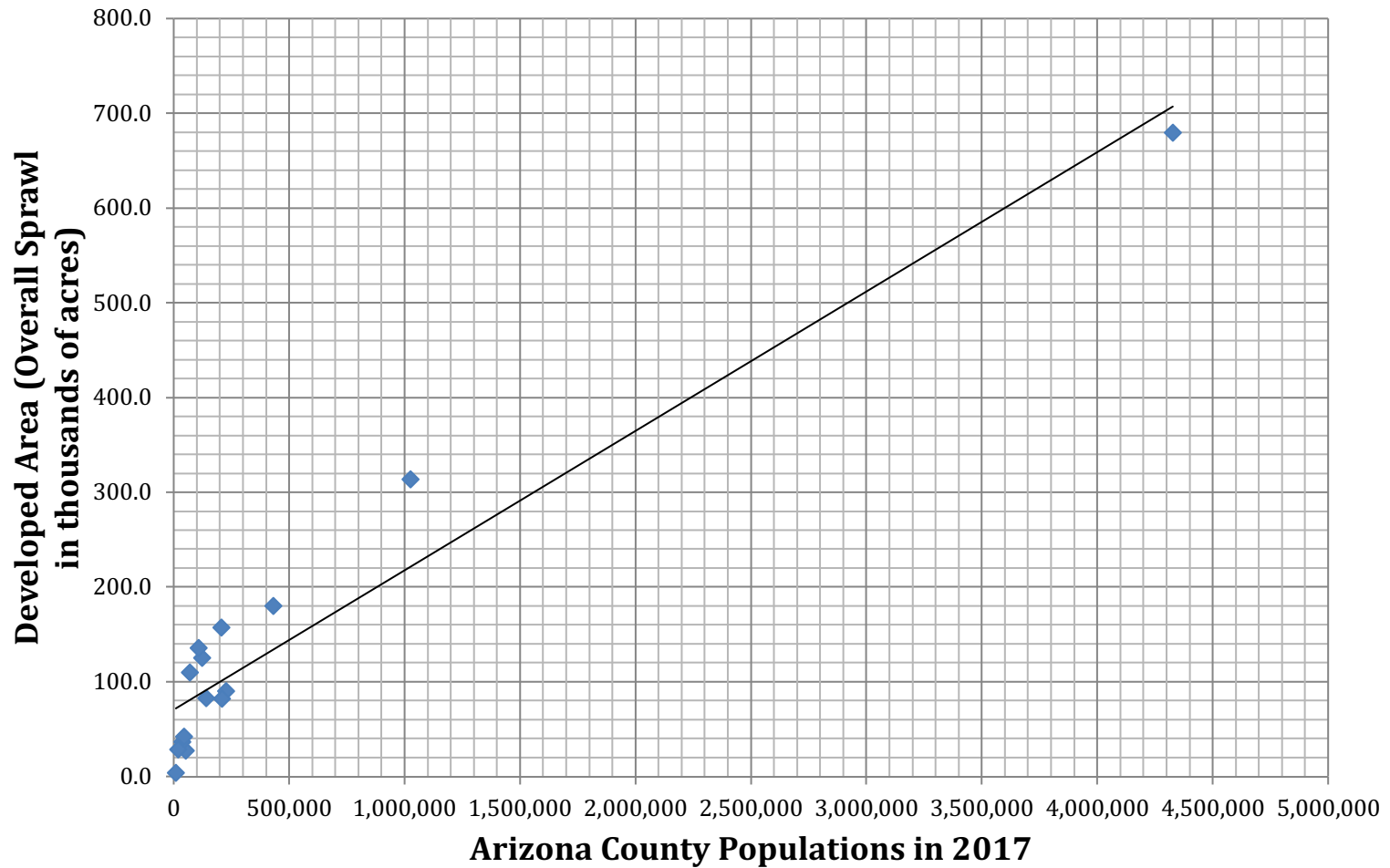
**Scatter Plot for Alabama County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.97**

**Arizona**

| <b>Arizona County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Apache                | 52,152                 | 71,545                 | 19,393                         | 37                               | 67.7  | 110.0   | 66   | 62                                | 65   |
| Cochise               | 88,373                 | 124,864                | 36,491                         | 41                               | 69.4  | 125.7   | 88   | 81                                | 58   |
| Coconino              | 79,156                 | 141,001                | 61,845                         | 78                               | 48.2  | 83.1  | 55   | 72                                | 100  |
| Gila                  | 38,924                 | 53,578                 | 14,654                         | 38                               | 16.5  | 27.9  | 18   | 69                                | 61   |
| Graham                | 23,830                 | 37,481                 | 13,651                         | 57                               | 17.4  | 36.9  | 30   | 112                               | 60   |
| Greenlee              | 11,747                 | 9,443                  | -2,304                         | -20                              | 2.7   | 4.3   | 3  | 59                                | 0  |
| La Paz                | 12,692                 | 20,706                 | 8,014                          | 63                               | 10.9  | 28.9  | 28   | 165                               | 50   |
| Maricopa              | 1,611,847              | 4,327,184              | 2,715,337                      | 168                              | 264.4   | 679.3   | 648  | 157                               | 100  |
| Mohave                | 62,539                 | 207,017                | 144,478                        | 231                              | 50.2  | 157.6   | 168  | 214                               | 100  |
| Navajo                | 66,910                 | 109,079                | 42,169                         | 63                               | 98.9  | 136.0   | 58   | 38                                | 100  |
| Pima                  | 568,004                | 1,026,391              | 458,387                        | 81                               | 201.5   | 313.8   | 175  | 56                                | 100  |

| <b>Arizona County</b>   | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Pinal                   | 96,802                 | 431,564                | 334,762                        | 346                              | 53.3  | 180.0   | 198  | 238                               | 100  |
| Santa Cruz              | 21,689                 | 46,566                 | 24,877                         | 115                              | 24.0  | 42.5  | 29   | 77                                | 100  |
| Yavapai                 | 74,009                 | 228,082                | 154,073                        | 208                              | 38.3  | 90.6  | 82   | 137                               | 100  |
| Yuma                    | 81,186                 | 209,507                | 128,321                        | 158                              | 19.3  | 82.3  | 98   | 326                               | 65   |
| <b>Totals</b>           | <b>2,889,860</b>       | <b>7,044,008</b>       | <b>4,154,148</b>               | <b>144</b>                       | <b>982.7</b>                                  | <b>2,098.9</b>                                | <b>1,744</b>   | <b>114</b>                        | <b>100</b>                                   |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>93</b>                                    |



**Scatter Plot for Arizona County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.96**

| Arkansas County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Arkansas Co.    | 24,114          | 17,872          | -6,242                  | -26                       | 11.5                                   | 11.9                                   | 0.6   | 3                          | 0                                     |
| Ashley Co.      | 26,273          | 20,311          | -5,962                  | -23                       | 8.3                                    | 10.7                                   | 3.8   | 29                         | 0                                     |
| Baxter Co.      | 28,024          | 41,308          | 13,284                  | 47                        | 21.4                                   | 37.3                                   | 24.8  | 74                         | 70                                    |
| Benton Co.      | 80,220          | 266,585         | 186,365                 | 232                       | 49.0                                   | 106.6                                  | 90.0  | 118                        | 100                                   |
| Boone Co.       | 26,456          | 37,459          | 11,003                  | 42                        | 12.3                                   | 22.9                                   | 16.6  | 86                         | 56                                    |
| Bradley Co.     | 13,388          | 10,813          | -2,575                  | -19                       | 4.4                                    | 9.0                                    | 7.2   | 105                        | 0                                     |
| Calhoun Co.     | 6,113           | 5,201           | -912                    | -15                       | 13.2                                   | 14.8                                   | 2.5   | 12                         | 0                                     |
| Carroll Co.     | 16,411          | 27,865          | 11,454                  | 70                        | 14.4                                   | 22.5                                   | 12.7  | 56                         | 100                                   |
| Chicot Co.      | 18,032          | 10,647          | -7,385                  | -41                       | 10.0                                   | 13.9                                   | 6.1   | 39                         | 0                                     |
| Clark Co.       | 22,997          | 22,184          | -813                    | -4                        | 12.1                                   | 23.6                                   | 18.0  | 95                         | 0                                     |
| Clay Co.        | 20,078          | 14,865          | -5,213                  | -26                       | 10.0                                   | 10.8                                   | 1.3   | 8                          | 0                                     |

| Arkansas County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Cleburne Co.    | 17,315          | 25,059          | 7,744                   | 45                        | 12.2                                   | 31.4                                   | 30.0  | 157                        | 39                                    |
| Cleveland Co.   | 7,884           | 8,162           | 278                     | 4                         | 4.7                                    | 7.2                                    | 3.9   | 53                         | 8                                     |
| Columbia Co.    | 26,974          | 23,695          | -3,279                  | -12                       | 16.1                                   | 23.5                                   | 11.6  | 46                         | 0                                     |
| Conway Co.      | 19,249          | 20,810          | 1,561                   | 8                         | 12.1                                   | 18.7                                   | 10.3  | 55                         | 18                                    |
| Craighead Co.   | 63,046          | 107,188         | 44,142                  | 70                        | 30.5                                   | 55.1                                   | 38.4  | 81                         | 90                                    |
| Crawford Co.    | 37,152          | 62,894          | 25,742                  | 69                        | 13.2                                   | 27.7                                   | 22.7  | 110                        | 71                                    |
| Crittenden Co.  | 49,347          | 48,716          | -631                    | -1                        | 24.5                                   | 31.0                                   | 10.2  | 27                         | 0                                     |
| Cross Co.       | 20,497          | 16,792          | -3,705                  | -18                       | 9.8                                    | 17.2                                   | 11.6  | 76                         | 0                                     |
| Dallas Co.      | 10,512          | 7,307           | -3,205                  | -30                       | 6.7                                    | 7.2                                    | 0.8   | 7                          | 0                                     |
| Desha Co.       | 19,361          | 11,743          | -7,618                  | -39                       | 5.9                                    | 7.6                                    | 2.7   | 29                         | 0                                     |
| Drew Co.        | 17,902          | 18,370          | 468                     | 3                         | 13.8                                   | 19.0                                   | 8.1   | 38                         | 8                                     |
| Faulkner Co.    | 47,338          | 123,530         | 76,192                  | 161                       | 18.7                                   | 51.2                                   | 50.8  | 174                        | 95                                    |

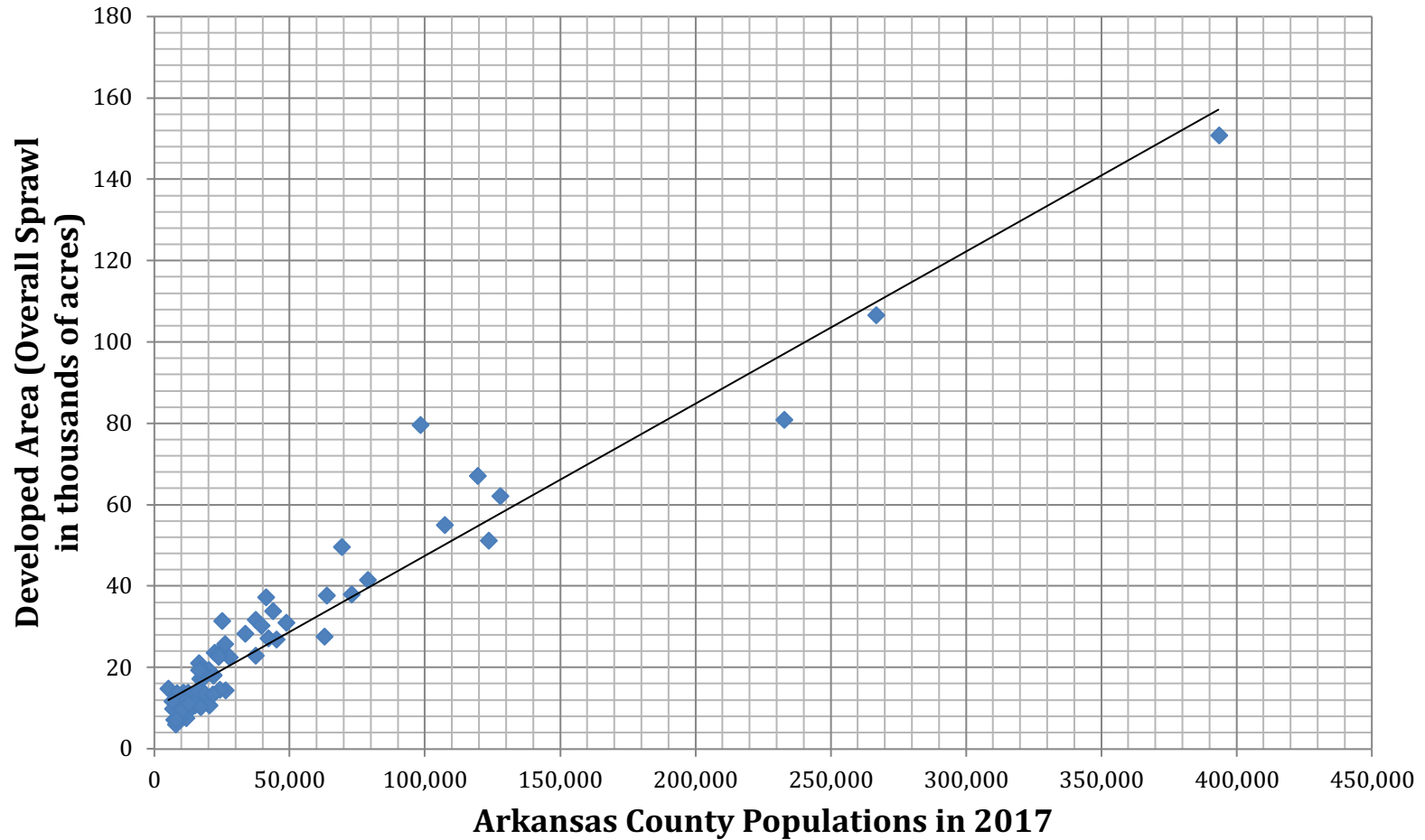
| Arkansas County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Franklin Co.     | 14,802          | 17,809          | 3,007                   | 20                        | 12.9                                   | 17.8                                   | 7.7   | 38                         | 57                                    |
| Fulton Co.       | 9,864           | 12,131          | 2,267                   | 23                        | 6.6                                    | 9.1                                    | 3.9   | 38                         | 64                                    |
| Garland Co.      | 70,534          | 98,327          | 27,793                  | 39                        | 59.2                                   | 79.6                                   | 31.9  | 34                         | 100                                   |
| Grant Co.        | 12,840          | 18,103          | 5,263                   | 41                        | 15.1                                   | 17.5                                   | 3.8   | 16                         | 100                                   |
| Greene Co.       | 30,855          | 44,993          | 14,138                  | 46                        | 16.1                                   | 26.9                                   | 16.9  | 67                         | 73                                    |
| Hempstead Co.    | 23,242          | 21,876          | -1,366                  | -6                        | 10.8                                   | 18.1                                   | 11.4  | 68                         | 0                                     |
| Hot Spring Co.   | 26,415          | 33,606          | 7,191                   | 27                        | 16.8                                   | 28.3                                   | 18.0  | 68                         | 46                                    |
| Howard Co.       | 13,452          | 13,365          | -87                     | -1                        | 6.3                                    | 10.3                                   | 6.3   | 63                         | 0                                     |
| Independence Co. | 31,368          | 37,391          | 6,023                   | 19                        | 19.4                                   | 31.8                                   | 19.4  | 64                         | 36                                    |
| Izard Co.        | 10,743          | 13,666          | 2,923                   | 27                        | 8.5                                    | 12.3                                   | 5.9   | 45                         | 65                                    |
| Jackson Co.      | 21,216          | 17,017          | -4,199                  | -20                       | 12.8                                   | 14.4                                   | 2.5   | 13                         | 0                                     |
| Jefferson Co.    | 89,524          | 69,238          | -20,286                 | -23                       | 34.6                                   | 49.7                                   | 23.6  | 44                         | 0                                     |

| Arkansas County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Johnson Co.      | 17,883          | 26,401          | 8,518                   | 48                        | 9.6                                    | 14.4                                   | 7.5   | 50                         | 96                                    |
| Lafayette Co.    | 10,131          | 6,797           | -3,334                  | -33                       | 8.9                                    | 9.9                                    | 1.6   | 11                         | 0                                     |
| Lawrence Co.     | 18,465          | 16,571          | -1,894                  | -10                       | 12.0                                   | 14.6                                   | 4.1   | 22                         | 0                                     |
| Lee Co.          | 15,366          | 9,127           | -6,239                  | -41                       | 10.6                                   | 11.9                                   | 2.0   | 12                         | 0                                     |
| Lincoln Co.      | 13,130          | 13,475          | 345                     | 3                         | 8.0                                    | 12.0                                   | 6.3   | 50                         | 6                                     |
| Little River Co. | 13,933          | 12,373          | -1,560                  | -11                       | 8.0                                    | 13.8                                   | 9.1   | 73                         | 0                                     |
| Logan Co.        | 20,260          | 21,739          | 1,479                   | 7                         | 12.5                                   | 18.1                                   | 8.8   | 45                         | 19                                    |
| Lonoke Co.       | 35,080          | 72,778          | 37,698                  | 107                       | 24.9                                   | 38.0                                   | 20.5  | 53                         | 100                                   |
| Madison Co.      | 11,300          | 16,299          | 4,999                   | 44                        | 9.5                                    | 14.3                                   | 7.5   | 51                         | 90                                    |
| Marion Co.       | 11,523          | 16,429          | 4,906                   | 43                        | 9.9                                    | 21.1                                   | 17.5  | 113                        | 47                                    |
| Miller Co.       | 38,501          | 43,736          | 5,235                   | 14                        | 20.9                                   | 33.9                                   | 20.3  | 62                         | 26                                    |
| Mississippi Co.  | 59,340          | 42,112          | -17,228                 | -29                       | 19.9                                   | 27.2                                   | 11.4  | 37                         | 0                                     |

| Arkansas County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Monroe Co.      | 13,705          | 7,013           | -6,692                  | -49                       | 9.5                                    | 11.8                                   | 3.6   | 24                         | 0                                     |
| Montgomery Co.  | 7,571           | 8,890           | 1,319                   | 17                        | 5.6                                    | 7.8                                    | 3.4   | 39                         | 48                                    |
| Nevada Co.      | 11,036          | 8,309           | -2,727                  | -25                       | 3.9                                    | 6.7                                    | 4.4   | 72                         | 0                                     |
| Newton Co.      | 7,619           | 7,815           | 196                     | 3                         | 4.6                                    | 6.0                                    | 2.2   | 30                         | 10                                    |
| Ouachita Co.    | 30,923          | 23,817          | -7,106                  | -23                       | 17.9                                   | 22.6                                   | 7.3   | 26                         | 0                                     |
| Perry Co.       | 7,480           | 10,346          | 2,866                   | 38                        | 4.8                                    | 9.3                                    | 7.0   | 94                         | 49                                    |
| Phillips Co.    | 33,596          | 18,599          | -14,997                 | -45                       | 13.1                                   | 13.6                                   | 0.8   | 4                          | 0                                     |
| Pike Co.        | 10,115          | 10,735          | 620                     | 6                         | 8.4                                    | 12.6                                   | 6.6   | 50                         | 15                                    |
| Poinsett Co.    | 26,257          | 24,071          | -2,186                  | -8                        | 11.3                                   | 14.6                                   | 5.2   | 29                         | 0                                     |
| Polk Co.        | 17,081          | 20,147          | 3,066                   | 18                        | 11.4                                   | 19.4                                   | 12.5  | 70                         | 31                                    |
| Pope Co.        | 40,342          | 63,634          | 23,292                  | 58                        | 28.1                                   | 37.7                                   | 15.0  | 34                         | 100                                   |
| Prairie Co.     | 10,099          | 8,248           | -1,851                  | -18                       | 12.1                                   | 13.7                                   | 2.5   | 13                         | 0                                     |

| Arkansas County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Pulaski Co.     | 343,579         | 393,280         | 49,701                  | 14                        | 112.3                                  | 150.8                                  | 60.2  | 34                         | 46                                    |
| Randolph Co.    | 16,329          | 17,665          | 1,336                   | 8                         | 16.0                                   | 19.2                                   | 5.0   | 20                         | 43                                    |
| St. Francis Co. | 30,942          | 25,997          | -4,945                  | -16                       | 20.2                                   | 25.8                                   | 8.8   | 28                         | 0                                     |
| Saline Co.      | 54,989          | 119,520         | 64,531                  | 117                       | 38.7                                   | 67.1                                   | 44.4  | 73                         | 100                                   |
| Scott Co.       | 9,594           | 10,369          | 775                     | 8                         | 8.4                                    | 9.6                                    | 1.9   | 14                         | 58                                    |
| Searcy Co.      | 8,752           | 7,927           | -825                    | -9                        | 5.2                                    | 7.2                                    | 3.1   | 38                         | 0                                     |
| Sebastian Co.   | 95,368          | 127,786         | 32,418                  | 34                        | 42.5                                   | 62.1                                   | 30.6  | 46                         | 77                                    |
| Sevier Co.      | 13,987          | 17,103          | 3,116                   | 22                        | 4.9                                    | 10.3                                   | 8.4   | 110                        | 27                                    |
| Sharp Co.       | 14,374          | 17,147          | 2,773                   | 19                        | 10.3                                   | 19.4                                   | 14.2  | 88                         | 28                                    |
| Stone Co.       | 9,121           | 12,520          | 3,399                   | 37                        | 6.3                                    | 11.1                                   | 7.5   | 76                         | 56                                    |
| Union Co.       | 48,547          | 39,460          | -9,087                  | -19                       | 25.7                                   | 30.3                                   | 7.2   | 18                         | 0                                     |
| Van Buren Co.   | 13,520          | 16,552          | 3,032                   | 22                        | 13.7                                   | 19.4                                   | 8.9   | 42                         | 58                                    |

| <b>Arkansas County</b>  | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Washington Co.          | 101,464                | 232,732                | 131,268                        | 129                              | 32.5  | 80.9  | 75.6   | 149                               | 91   |
| White Co.               | 51,308                 | 78,844                 | 27,536                         | 54                               | 22.8  | 41.6  | 29.4   | 82                                | 71   |
| Woodruff Co.            | 10,931                 | 6,575                  | -4,356                         | -40                              | 11.3  | 11.7  | 0.6  | 4                                 | 0  |
| Yell Co.                | 17,175                 | 21,509                 | 4,334                          | 25                               | 9.1   | 13.4  | 6.7  | 47                                | 58   |
| <b>Totals</b>           | <b>2,294,254</b>       | <b>3,001,345</b>       | <b>707,091</b>                 | <b>31</b>                        | <b>1,219.2</b>                                | <b>1,881.5</b>                                | <b>1,034.8</b>   | <b>54</b>                         | <b>62</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>58</b>                                    |



**Scatter Plot for Arkansas County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.96**

**California**

| <b>California County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Alameda Co.              | 1,140,269              | 1,660,196              | 519,927                        | 46                               | 128.3   | 164.4   | 56.4   | 28                                | 100  |
| Alpine Co.               | 1,145                  | 1,111                  | -34                            | -3                               | 0.4   | 1.6   | 1.9  | 300                               | 0  |
| Amador Co.               | 20,605                 | 38,529                 | 17,924                         | 87                               | 15.7  | 30.2  | 22.7   | 92                                | 96   |
| Butte Co.                | 151,913                | 228,696                | 76,783                         | 51                               | 30.6  | 47.6  | 26.6   | 56                                | 93   |
| Calaveras Co.            | 22,778                 | 45,681                 | 22,903                         | 101                              | 8.2   | 32.1  | 37.3   | 291                               | 51   |
| Colusa Co.               | 13,872                 | 21,579                 | 7,707                          | 56                               | 8.8   | 11.5  | 4.2  | 31                                | 100  |
| Contra Costa Co.         | 678,903                | 1,145,535              | 466,632                        | 69                               | 107.2   | 153.7   | 72.7   | 43                                | 100  |
| Del Norte Co.            | 18,571                 | 27,351                 | 8,780                          | 47                               | 10.0  | 21.0  | 17.2   | 110                               | 52   |
| El Dorado Co.            | 92,428                 | 188,679                | 96,251                         | 104                              | 47.8  | 80.0  | 50.3   | 67                                | 100  |
| Fresno Co.               | 541,500                | 985,238                | 443,738                        | 82                               | 144.5   | 225.8   | 127.0  | 56                                | 100  |
| Glenn Co.                | 22,346                 | 27,926                 | 5,580                          | 25                               | 10.8  | 14.6  | 5.9  | 35                                | 74   |

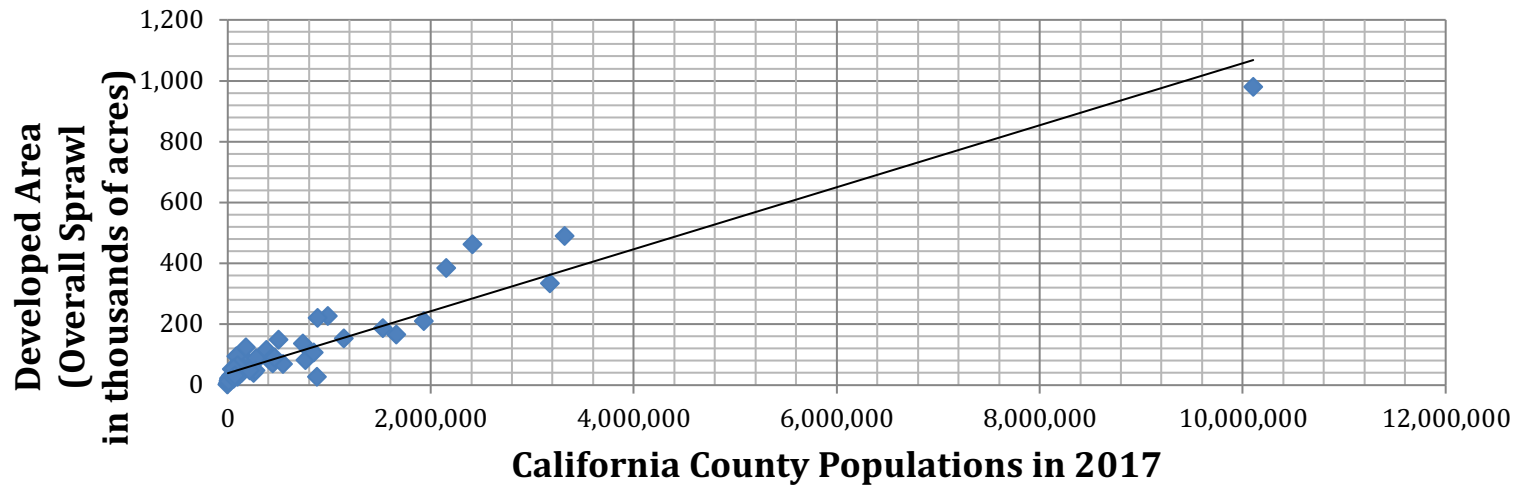
| California County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Humboldt Co.      | 109,889         | 136,507         | 26,618                  | 24                        | 45.1                                   | 62.2                                   | 26.7  | 38                         | 67                                    |
| Imperial Co.      | 95,688          | 181,649         | 85,961                  | 90                        | 29.4                                   | 80.5                                   | 79.8  | 174                        | 64                                    |
| Inyo Co.          | 18,410          | 17,868          | -542                    | -3                        | 12.3                                   | 19.1                                   | 10.6  | 55                         | 0                                     |
| Kern Co.          | 433,698         | 887,356         | 453,658                 | 105                       | 114.0                                  | 220.8                                  | 166.9   | 94                         | 100                                   |
| Kings Co.         | 78,213          | 149,665         | 71,452                  | 91                        | 34.9                                   | 47.7                                   | 20.0  | 37                         | 100                                   |
| Lake Co.          | 39,991          | 64,111          | 24,120                  | 60                        | 18.9                                   | 27.7                                   | 13.8  | 47                         | 100                                   |
| Lassen Co.        | 23,370          | 30,920          | 7,550                   | 32                        | 19.8                                   | 27.6                                   | 12.2  | 39                         | 84                                    |
| Los Angeles Co.   | 7,767,422       | 10,103,711      | 2,336,289               | 30                        | 841.0                                  | 978.2                                  | 214.4   | 16                         | 100                                   |
| Madera Co.        | 69,240          | 155,423         | 86,183                  | 124                       | 37.3                                   | 54.2                                   | 26.4  | 45                         | 100                                   |
| Marin Co.         | 223,426         | 259,749         | 36,323                  | 16                        | 26.6                                   | 39.3                                   | 19.8  | 48                         | 39                                    |
| Mariposa Co.      | 11,798          | 17,414          | 5,616                   | 48                        | 18.5                                   | 22.2                                   | 5.8   | 20                         | 100                                   |
| Mendocino Co.     | 69,726          | 87,576          | 17,850                  | 26                        | 68.2                                   | 93.0                                   | 38.8  | 36                         | 73                                    |

| California County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Merced Co.        | 142,766         | 271,096         | 128,330                 | 90                        | 47.8                                   | 74.8                                   | 42.2  | 56                         | 100                                   |
| Modoc Co.         | 9,268           | 8,876           | -392                    | -4                        | 11.1                                   | 13.3                                   | 3.4   | 20                         | 0                                     |
| Mono Co.          | 9,278           | 14,354          | 5,076                   | 55                        | 7.5                                    | 10.3                                   | 4.4   | 37                         | 100                                   |
| Monterey Co.      | 306,241         | 434,534         | 128,293                 | 42                        | 62.0                                   | 76.0                                   | 21.9  | 23                         | 100                                   |
| Napa Co.          | 101,178         | 139,878         | 38,700                  | 38                        | 27.4                                   | 39.8                                   | 19.4  | 45                         | 87                                    |
| Nevada Co.        | 59,087          | 99,367          | 40,280                  | 68                        | 33.8                                   | 63.8                                   | 46.9  | 89                         | 82                                    |
| Orange Co.        | 2,045,925       | 3,174,289       | 1,128,364               | 55                        | 237.2                                  | 333.3                                  | 150.2   | 41                         | 100                                   |
| Placer Co.        | 126,216         | 385,115         | 258,899                 | 205                       | 47.1                                   | 114.9                                  | 105.9   | 144                        | 100                                   |
| Plumas Co.        | 18,176          | 18,660          | 484                     | 3                         | 12.4                                   | 19.6                                   | 11.3  | 58                         | 6                                     |
| Riverside Co.     | 719,842         | 2,414,964       | 1,695,122               | 235                       | 209.1                                  | 462.3                                  | 395.6   | 121                        | 100                                   |
| Sacramento Co.    | 832,148         | 1,527,301       | 695,153                 | 84                        | 111.5                                  | 187.2                                  | 118.3   | 68                         | 100                                   |
| San Benito Co.    | 26,916          | 60,164          | 33,248                  | 124                       | 11.2                                   | 20.3                                   | 14.2  | 81                         | 100                                   |

| <b>California County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| San Bernardino Co.       | 966,760                | 2,150,945              | 1,184,185                      | 122                              | 192.9   | 384.3   | 299.1  | 99                                | 100  |
| San Diego Co.            | 1,972,354              | 3,321,237              | 1,348,883                      | 68                               | 272.4   | 489.9   | 339.8  | 80                                | 89   |
| San Francisco Co.        | 695,546                | 878,040                | 182,494                        | 26                               | 22.8  | 26.1  | 5.2  | 14                                | 100  |
| San Joaquin Co.          | 373,479                | 743,296                | 369,817                        | 99                               | 86.1  | 136.7   | 79.1   | 59                                | 100  |
| San Luis Obispo Co.      | 166,563                | 282,481                | 115,918                        | 70                               | 52.2  | 87.3  | 54.8   | 67                                | 100  |
| San Mateo Co.            | 595,851                | 768,901                | 173,050                        | 29                               | 64.8  | 80.5  | 24.5   | 24                                | 100  |
| Santa Barbara Co.        | 313,073                | 445,298                | 132,225                        | 42                               | 59.6  | 92.5  | 51.4   | 55                                | 80   |
| Santa Clara Co.          | 1,345,039              | 1,932,510              | 587,471                        | 44                               | 169.7   | 210.0   | 63.0   | 24                                | 100  |
| Santa Cruz Co.           | 197,353                | 274,856                | 77,503                         | 39                               | 34.9  | 48.0  | 20.5   | 38                                | 100  |
| Shasta Co.               | 121,513                | 179,384                | 57,871                         | 48                               | 75.7  | 123.6   | 74.8   | 63                                | 79   |
| Sierra Co.               | 3,276                  | 3,002                  | -274                           | -8                               | 3.6   | 5.5   | 3.0  | 53                                | 0  |

| California County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Siskiyou Co.      | 41,279          | 43,622          | 2,343                   | 6                         | 45.5                                   | 51.8                                   | 9.8   | 14                         | 43                                    |
| Solano Co.        | 254,348         | 443,511         | 189,163                 | 74                        | 31.5                                   | 69.8                                   | 59.8  | 122                        | 70                                    |
| Sonoma Co.        | 314,636         | 502,469         | 187,833                 | 60                        | 105.8                                  | 148.2                                  | 66.3  | 40                         | 100                                   |
| Stanislaus Co.    | 280,737         | 544,717         | 263,980                 | 94                        | 44.4                                   | 68.7                                   | 38.0  | 55                         | 100                                   |
| Sutter Co.        | 55,230          | 96,204          | 40,974                  | 74                        | 16.7                                   | 25.7                                   | 14.1  | 54                         | 100                                   |
| Tehama Co.        | 41,329          | 63,847          | 22,518                  | 54                        | 27.3                                   | 55.0                                   | 43.3  | 101                        | 62                                    |
| Trinity Co.       | 12,316          | 12,726          | 410                     | 3                         | 10.2                                   | 12.2                                   | 3.1   | 20                         | 18                                    |
| Tulare Co.        | 259,759         | 462,308         | 202,549                 | 78                        | 48.0                                   | 90.7                                   | 66.7  | 89                         | 91                                    |
| Tuolumne Co.      | 36,259          | 53,976          | 17,717                  | 49                        | 11.6                                   | 24.0                                   | 19.4  | 107                        | 55                                    |
| Ventura Co.       | 562,142         | 849,044         | 286,902                 | 51                        | 70.9                                   | 105.5                                  | 54.1  | 49                         | 100                                   |
| Yolo Co.          | 117,748         | 218,477         | 100,729                 | 86                        | 32.1                                   | 48.0                                   | 24.8  | 50                         | 100                                   |
| Yuba Co.          | 51,175          | 76,578          | 25,403                  | 50                        | 21.6                                   | 31.2                                   | 15.0  | 44                         | 100                                   |

| California County       | 1982 Population   | 2017 Population   | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-------------------|-------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Totals</b>           | <b>24,820,007</b> | <b>39,358,497</b> | <b>14,538,490</b>       | <b>59</b>                 | <b>4,096.7</b>                         | <b>6,285.8</b>                         | <b>3,420.5</b>                                    | <b>53</b>                  | <b>100</b>                            |
| <b>Weighted Average</b> |                   |                   |                         |                           |  |  |   |                            | <b>93</b>                             |



**Scatter Plot for California County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.95**

**Colorado**

| Colorado County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Adams Co.       | 258,855         | 503,590         | 244,735                 | 95                        | 43.9                                   | 95.3                                   | 80.3  | 117                        | 86                                    |
| Alamosa Co.     | 12,344          | 16,108          | 3,764                   | 30                        | 6.8                                    | 14.0                                   | 11.3  | 106                        | 37                                    |
| Arapahoe Co.    | 330,653         | 644,478         | 313,825                 | 95                        | 56.0                                   | 99.2                                   | 67.5  | 77                         | 100                                   |
| Archuleta Co.   | 4,296           | 13,295          | 8,999                   | 209                       | 8.1                                    | 25.3                                   | 26.9  | 212                        | 99                                    |
| Baca Co.        | 5,241           | 3,554           | -1,687                  | -32                       | 17.9                                   | 18.2                                   | 0.5   | 2                          | 0                                     |
| Bent Co.        | 5,839           | 5,827           | -12                     | 0                         | 10.4                                   | 11.4                                   | 1.6   | 10                         | 0                                     |
| Boulder Co.*    | 200,827         | 390,704         | 189,877                 | 95                        | 58.2                                   | 92.0                                   | 52.8  | 58                         | 100                                   |
| Broomfield Co.* |                 |                 |                         |                           |  |  |   |                            |                                       |
| Chaffee Co.     | 13,337          | 19,666          | 6,329                   | 47                        | 11.1                                   | 14.6                                   | 5.5   | 32                         | 100                                   |
| Cheyenne Co.    | 2,279           | 1,853           | -426                    | -19                       | 16.3                                   | 17.5                                   | 1.9   | 7                          | 0                                     |
| Clear Creek Co. | 7,655           | 9,574           | 1,919                   | 25                        | 3.2                                    | 7.0                                    | 5.9   | 119                        | 29                                    |

| Colorado County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Conejos Co.     | 7,671           | 8,139           | 468                     | 6                         | 8.1                                    | 9.6                                    | 2.3   | 19                         | 35                                    |
| Costilla Co.    | 3,131           | 3,756           | 625                     | 20                        | 11.9                                   | 15.3                                   | 5.3   | 29                         | 72                                    |
| Crowley Co.     | 3,006           | 5,840           | 2,834                   | 94                        | 6.1                                    | 6.5                                    | 0.6   | 7                          | 100                                   |
| Custer Co.      | 1,629           | 4,857           | 3,228                   | 198                       | 12.4                                   | 25.9                                   | 21.1  | 109                        | 100                                   |
| Delta Co.       | 23,414          | 30,519          | 7,105                   | 30                        | 3.8                                    | 9.7                                    | 9.2   | 155                        | 28                                    |
| Denver Co.      | 504,576         | 704,961         | 200,385                 | 40                        | 64.8                                   | 83.5                                   | 29.2  | 29                         | 100                                   |
| Dolores Co.     | 1,669           | 2,045           | 376                     | 23                        | 2.4                                    | 3.0                                    | 0.9   | 25                         | 91                                    |
| Douglas Co.     | 29,829          | 335,816         | 305,987                 | 1026                      | 39.1                                   | 123.2                                  | 131.4   | 215                        | 100                                   |
| Eagle Co.       | 15,822          | 54,929          | 39,107                  | 247                       | 13.0                                   | 30.6                                   | 27.5  | 135                        | 100                                   |
| Elbert Co.      | 7,432           | 25,765          | 18,333                  | 247                       | 18.0                                   | 22.7                                   | 7.3   | 26                         | 100                                   |
| El Paso Co.     | 332,335         | 700,099         | 367,764                 | 111                       | 105.6                                  | 217.6                                  | 175.0   | 106                        | 100                                   |
| Fremont Co.     | 29,841          | 47,548          | 17,707                  | 59                        | 14.7                                   | 28.7                                   | 21.9  | 95                         | 70                                    |

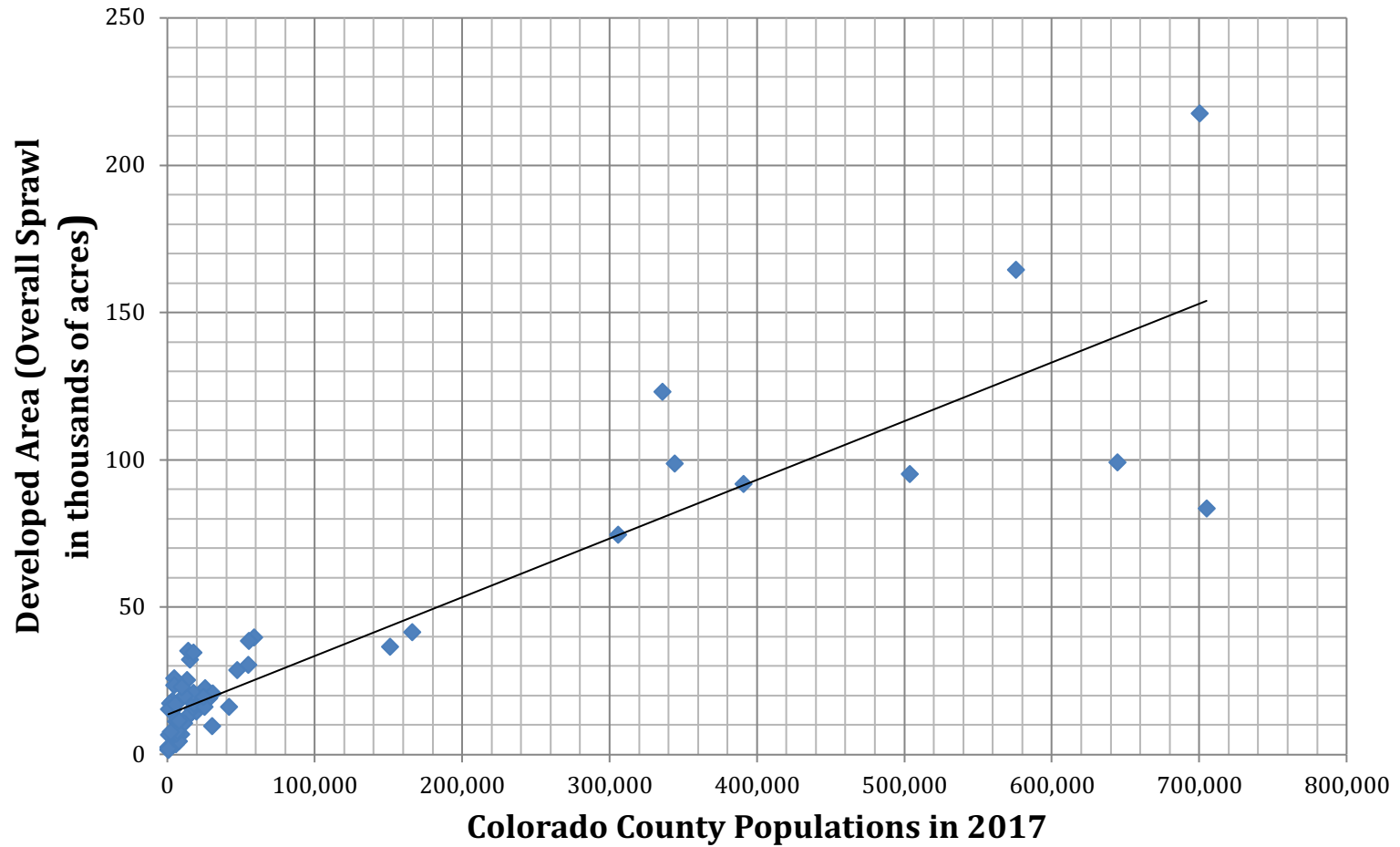
| Colorado County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Garfield Co.    | 28,510          | 59,032          | 30,522                  | 107                       | 19.9                                   | 39.9                                   | 31.3  | 101                        | 100                                   |
| Gilpin Co.      | 2,666           | 6,018           | 3,352                   | 126                       | 1.8                                    | 3.6                                    | 2.8   | 100                        | 100                                   |
| Grand Co.       | 8,068           | 15,364          | 7,296                   | 90                        | 22.5                                   | 32.3                                   | 15.3  | 44                         | 100                                   |
| Gunnison Co.    | 10,872          | 16,863          | 5,991                   | 55                        | 13.0                                   | 15.7                                   | 4.2   | 21                         | 100                                   |
| Hinsdale Co.    | 440             | 791             | 351                     | 80                        | 0.7                                    | 1.6                                    | 1.4   | 129                        | 71                                    |
| Huerfano Co.    | 6,665           | 6,628           | -37                     | -1                        | 9.3                                    | 12.3                                   | 4.7   | 32                         | 0                                     |
| Jackson Co.     | 1,799           | 1,375           | -424                    | -24                       | 6.3                                    | 6.8                                    | 0.8   | 8                          | 0                                     |
| Jefferson Co.   | 393,547         | 575,417         | 181,870                 | 46                        | 103.3                                  | 164.6                                  | 95.8  | 59                         | 82                                    |
| Kiowa Co.       | 1,901           | 1,365           | -536                    | -28                       | 14.9                                   | 15.4                                   | 0.8   | 3                          | 0                                     |
| Kit Carson Co.  | 7,595           | 7,137           | -458                    | -6                        | 16.7                                   | 17.8                                   | 1.7   | 7                          | 0                                     |
| Lake Co.        | 8,464           | 7,750           | -714                    | -8                        | 2.8                                    | 4.5                                    | 2.7   | 61                         | 0                                     |
| La Plata Co.    | 29,346          | 55,563          | 26,217                  | 89                        | 14.4                                   | 38.6                                   | 37.8  | 168                        | 65                                    |

| Colorado County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Larimer Co.     | 157,410         | 344,084         | 186,674                 | 119                       | 55.9                                   | 98.8                                   | 67.0  | 77                         | 100                                   |
| Las Animas Co.  | 15,146          | 14,201          | -945                    | -6                        | 31.0                                   | 35.2                                   | 6.6   | 14                         | 0                                     |
| Lincoln Co.     | 4,545           | 5,523           | 978                     | 22                        | 15.4                                   | 17.0                                   | 2.5   | 10                         | 100                                   |
| Logan Co.       | 19,852          | 22,317          | 2,465                   | 12                        | 16.7                                   | 17.3                                   | 0.9   | 4                          | 100                                   |
| Mesa Co.        | 94,152          | 151,170         | 57,018                  | 61                        | 21.3                                   | 36.6                                   | 23.9  | 72                         | 87                                    |
| Mineral Co.     | 848             | 753             | -95                     | -11                       | 1.1                                    | 2.6                                    | 2.3   | 136                        | 0                                     |
| Moffat Co.      | 14,210          | 13,088          | -1,122                  | -8                        | 10.6                                   | 12.8                                   | 3.4   | 21                         | 0                                     |
| Montezuma Co.   | 17,999          | 26,112          | 8,113                   | 45                        | 8.6                                    | 18.9                                   | 16.1  | 120                        | 47                                    |
| Montrose Co.    | 25,505          | 41,753          | 16,248                  | 64                        | 7.0                                    | 16.3                                   | 14.5  | 133                        | 58                                    |
| Morgan Co.      | 22,565          | 28,295          | 5,730                   | 25                        | 15.1                                   | 19.3                                   | 6.6   | 28                         | 92                                    |
| Otero Co.       | 22,376          | 18,345          | -4,031                  | -18                       | 15.0                                   | 17.3                                   | 3.6   | 15                         | 0                                     |
| Ouray Co.       | 2,108           | 4,813           | 2,705                   | 128                       | 3.7                                    | 7.0                                    | 5.2   | 89                         | 100                                   |

| Colorado County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Park Co.        | 6,048           | 17,894          | 11,846                  | 196                       | 16.3                                   | 34.7                                   | 28.8  | 113                        | 100                                   |
| Phillips Co.    | 4,620           | 4,288           | -332                    | -7                        | 7.5                                    | 8.0                                    | 0.8   | 7                          | 0                                     |
| Pitkin Co.      | 10,662          | 17,973          | 7,311                   | 69                        | 13.2                                   | 21.1                                   | 12.3  | 60                         | 100                                   |
| Prowers Co.     | 13,262          | 11,998          | -1,264                  | -10                       | 19.5                                   | 20.1                                   | 0.9   | 3                          | 0                                     |
| Pueblo Co.      | 125,299         | 166,283         | 40,984                  | 33                        | 12.6                                   | 41.6                                   | 45.3  | 230                        | 24                                    |
| Rio Blanco Co.  | 7,029           | 6,352           | -677                    | -10                       | 5.5                                    | 7.2                                    | 2.7   | 31                         | 0                                     |
| Rio Grande Co.  | 10,914          | 11,297          | 383                     | 4                         | 8.9                                    | 10.7                                   | 2.8   | 20                         | 19                                    |
| Routt Co.       | 13,996          | 25,171          | 11,175                  | 80                        | 13.9                                   | 16.3                                   | 3.8   | 17                         | 100                                   |
| Saguache Co.    | 4,119           | 6,633           | 2,514                   | 61                        | 5.9                                    | 8.1                                    | 3.4   | 37                         | 100                                   |
| San Juan Co.    | 942             | 712             | -230                    | -24                       | 1.3                                    | 2.0                                    | 1.1   | 54                         | 0                                     |
| San Miguel Co.  | 3,017           | 8,034           | 5,017                   | 166                       | 7.1                                    | 11.5                                   | 6.9   | 62                         | 100                                   |
| Sedgwick Co.    | 3,225           | 2,311           | -914                    | -28                       | 5.8                                    | 7.8                                    | 3.1   | 34                         | 0                                     |

| Colorado County         | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Summit Co.              | 10,273           | 30,820           | 20,547                  | 200                       | 13.2                                   | 20.9                                   | 12.0  | 58                         | 100                                   |
| Teller Co.              | 9,083            | 24,674           | 15,591                  | 172                       | 8.1                                    | 19.6                                   | 18.0  | 142                        | 100                                   |
| Washington Co.          | 5,320            | 4,921            | -399                    | -8                        | 22.9                                   | 23.6                                   | 1.1   | 3                          | 0                                     |
| Weld Co.                | 125,733          | 305,885          | 180,152                 | 143                       | 60.1                                   | 74.7                                   | 22.8  | 24                         | 100                                   |
| Yuma Co.                | 9,750            | 9,959            | 209                     | 2                         | 21.3                                   | 23.1                                   | 2.8   | 8                          | 26                                    |
| <b>Totals</b>           | <b>3,061,562</b> | <b>5,611,885</b> | <b>2,550,323</b>        | <b>83</b>                 | <b>1,201.9</b>                         | <b>1,974.0</b>                         | <b>1,206.4</b>                                    | <b>64</b>                  | <b>100</b>                            |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>86</b>                             |

\* Broomfield County, the newest and smallest county by area in CO, was carved out of Boulder County in 2001; for the purposes of this study its population and small area are included with Boulder County

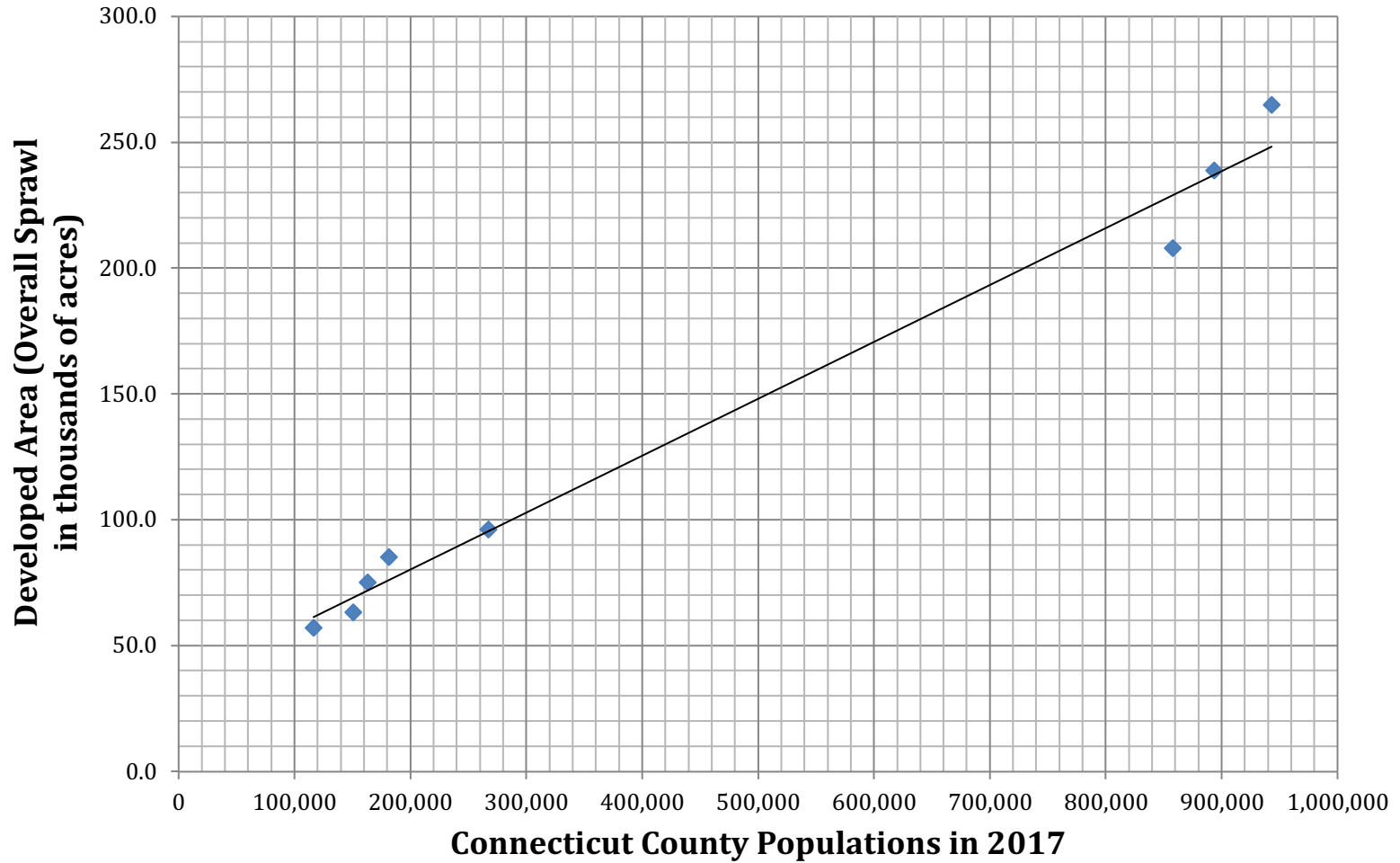


**Scatter Plot for Colorado County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.90**

**Connecticut**

| <b>Connecticut County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Fairfield Co              | 817,943                | 943,038                | 125,095                        | 15                               | 225.1   | 264.9   | 62.2   | 18                                | 87   |
| Hartford Co               | 812,390                | 893,076                | 80,686                         | 10                               | 191.8   | 238.8   | 73.4   | 25                                | 43   |
| Litchfield Co             | 159,431                | 181,667                | 22,236                         | 14                               | 57.1  | 85.3  | 44.1   | 49                                | 33   |
| Middlesex Co              | 130,084                | 162,942                | 32,858                         | 25                               | 51.1  | 75.1  | 37.5   | 47                                | 58   |
| New Haven Co              | 764,877                | 857,748                | 92,871                         | 12                               | 164.2   | 208.0   | 68.4   | 27                                | 48   |
| New London Co             | 243,051                | 267,419                | 24,368                         | 10                               | 69.5  | 96.2  | 41.7   | 38                                | 29   |
| Tolland Co                | 117,646                | 151,009                | 33,363                         | 28                               | 42.7  | 63.4  | 32.3   | 48                                | 63   |
| Windham Co                | 93,592                 | 116,398                | 22,806                         | 24                               | 43.0  | 57.2  | 22.2   | 33                                | 76   |
| <b>Totals</b>             | <b>3,139,014</b>       | <b>3,573,297</b>       | <b>434,283</b>                 | <b>14</b>                        | <b>844.5</b>                                  | <b>1,088.9</b>                                | <b>381.9</b>   | <b>29</b>                         | <b>51</b>                                    |
| <b>Weighted Average</b>   |                        |                        |                                |                                  |   |   |  |                                   | <b>53</b>                                    |

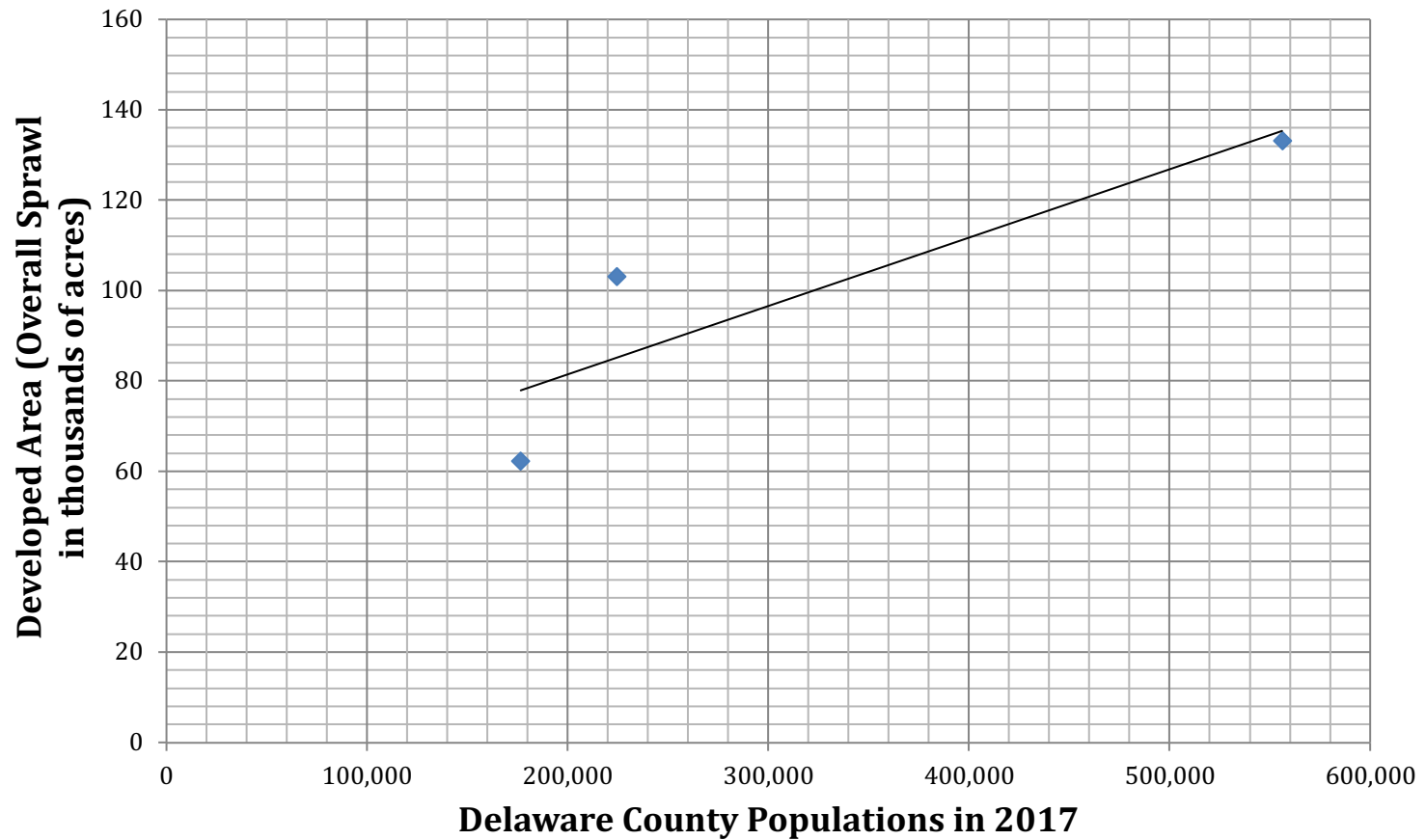


**Scatter Plot for Connecticut County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.99**

**Delaware**

| <b>Delaware County</b>  | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Kent Co                 | 99,225                 | 176,499                | 77,274                         | 78                               | 36.0  | 62.3  | 41.1   | 73                                | 100  |
| New Castle Co           | 401,475                | 555,976                | 154,501                        | 38                               | 78.9  | 133.1   | 84.7   | 69                                | 62   |
| Sussex Co               | 98,448                 | 224,348                | 125,900                        | 128                              | 44.9  | 103.1   | 90.9   | 130                               | 99   |
| <b>Totals</b>           | <b>599,148</b>         | <b>956,823</b>         | <b>357,675</b>                 | <b>60</b>                        | <b>159.8</b>                                  | <b>298.5</b>                                  | <b>216.7</b>   | <b>87</b>                         | <b>75</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>85</b>                                    |



**Scatter Plot for Delaware County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.88**

**Florida**

| <b>Florida County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Alachua Co.           | 159,113                | 266,309                | 107,196                        | 67                               | 54.1  | 92.6  | 60.2   | 71                                | 96   |
| Baker Co.             | 15,985                 | 28,254                 | 12,269                         | 77                               | 13.1  | 22.3  | 14.4   | 70                                | 100  |
| Bay Co.               | 103,904                | 184,736                | 80,832                         | 78                               | 41.0  | 84.3  | 67.7   | 106                               | 80   |
| Bradford Co.          | 21,151                 | 27,142                 | 5,991                          | 28                               | 13.7  | 25.4  | 18.3   | 85                                | 40   |
| Brevard Co.           | 299,098                | 587,769                | 288,671                        | 97                               | 69.8  | 142.0   | 112.8  | 103                               | 95   |
| Broward Co.           | 1,076,762              | 1,934,516              | 857,754                        | 80                               | 108.1   | 210.9   | 160.6  | 95                                | 88   |
| Calhoun Co.           | 9,214                  | 14,428                 | 5,214                          | 57                               | 6.7   | 11.2  | 7.0  | 67                                | 87   |
| Charlotte Co.         | 67,961                 | 181,522                | 113,561                        | 167                              | 60.6  | 95.1  | 53.9   | 57                                | 100  |
| Citrus Co.            | 62,938                 | 145,415                | 82,477                         | 131                              | 38.5  | 109.7   | 111.3  | 185                               | 80   |
| Clay Co.              | 73,798                 | 212,228                | 138,430                        | 188                              | 27.5  | 56.6  | 45.5   | 106                               | 100  |
| Collier Co.           | 99,902                 | 372,678                | 272,776                        | 273                              | 36.1  | 104.7   | 107.2  | 190                               | 100  |

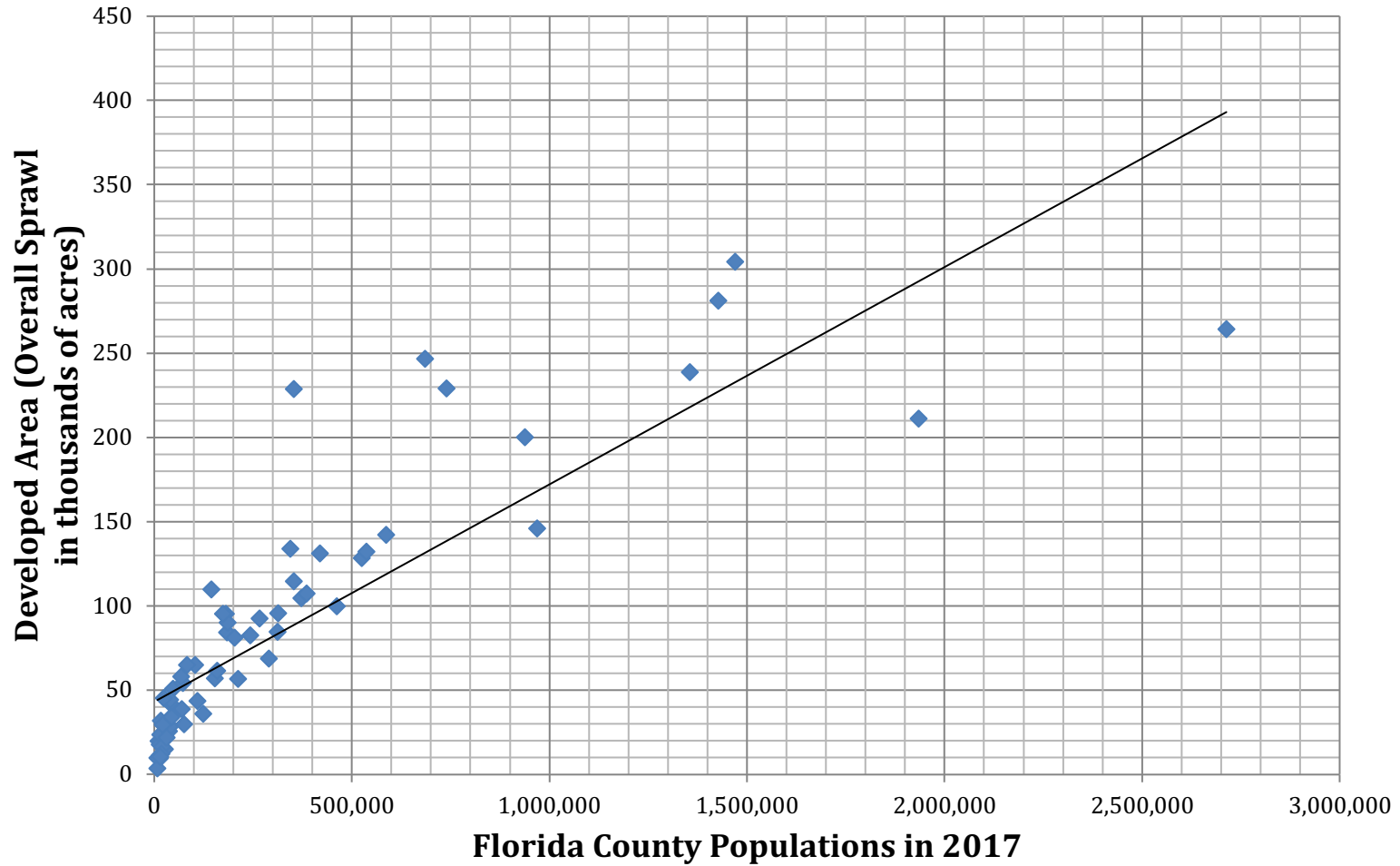
| <b>Florida County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Columbia Co.          | 37,104                 | 69,999                 | 32,895                         | 89                               | 19.5  | 38.8  | 30.2   | 99                                | 92   |
| DeSoto Co.            | 20,230                 | 37,241                 | 17,011                         | 84                               | 14.4  | 25.7  | 17.7   | 78                                | 100  |
| Dixie Co.             | 8,257                  | 16,615                 | 8,358                          | 101                              | 14.2  | 31.9  | 27.7   | 125                               | 86   |
| Duval Co.             | 587,011                | 937,933                | 350,922                        | 60                               | 104.2   | 199.9   | 149.5  | 92                                | 72   |
| Escambia Co.          | 243,310                | 313,249                | 69,939                         | 29                               | 61.8  | 95.5  | 52.7   | 55                                | 58   |
| Flagler Co.           | 13,074                 | 109,999                | 96,925                         | 741                              | 12.0  | 43.4  | 49.1   | 262                               | 100  |
| Franklin Co.          | 7,938                  | 11,724                 | 3,786                          | 48                               | 9.7   | 19.8  | 15.8   | 104                               | 55   |
| Gadsden Co.           | 41,991                 | 45,993                 | 4,002                          | 10                               | 15.6  | 34.8  | 30.0   | 123                               | 11   |
| Gilchrist Co.         | 6,838                  | 17,900                 | 11,062                         | 162                              | 10.0  | 19.9  | 15.5   | 99                                | 100  |
| Glades Co.            | 6,261                  | 13,580                 | 7,319                          | 117                              | 9.3   | 17.6  | 13.0   | 89                                | 100  |
| Gulf Co.              | 10,775                 | 16,105                 | 5,330                          | 49                               | 11.1  | 23.7  | 19.7   | 114                               | 53   |
| Hamilton Co.          | 9,082                  | 14,364                 | 5,282                          | 58                               | 5.6   | 9.3   | 5.8  | 66                                | 90   |

| <b>Florida County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Hardee Co.            | 20,267                 | 27,154                 | 6,887                          | 34                               | 9.4   | 14.8  | 8.4  | 57                                | 64   |
| Hendry Co.            | 20,503                 | 41,018                 | 20,515                         | 100                              | 15.8  | 28.5  | 19.8   | 80                                | 100  |
| Hernando Co.          | 55,341                 | 186,704                | 131,363                        | 237                              | 49.2  | 90.1  | 63.9   | 83                                | 100  |
| Highlands Co.         | 52,286                 | 103,852                | 51,566                         | 99                               | 34.3  | 64.8  | 47.7   | 89                                | 100  |
| Hillsborough Co.      | 688,100                | 1,426,736              | 738,636                        | 107                              | 136.5   | 281.0   | 225.8  | 106                               | 100  |
| Holmes Co.            | 15,255                 | 19,427                 | 4,172                          | 27                               | 6.9   | 16.2  | 14.5   | 135                               | 28   |
| Indian River Co.      | 67,499                 | 154,241                | 86,742                         | 129                              | 23.5  | 56.9  | 52.2   | 142                               | 93   |
| Jackson Co.           | 39,853                 | 48,289                 | 8,436                          | 21                               | 24.8  | 50.7  | 40.5   | 104                               | 27   |
| Jefferson Co.         | 10,947                 | 14,165                 | 3,218                          | 29                               | 3.7   | 10.1  | 10.0   | 173                               | 26   |
| Lafayette Co.         | 4,126                  | 8,602                  | 4,476                          | 108                              | 7.9   | 9.6   | 2.7  | 22                                | 100  |
| Lake Co.              | 113,470                | 345,432                | 231,962                        | 204                              | 44.7  | 133.7   | 139.1  | 199                               | 100  |
| Lee Co.               | 230,932                | 740,000                | 509,068                        | 220                              | 112.3   | 228.9   | 182.2  | 104                               | 100  |

| Florida County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Leon Co.        | 157,428         | 290,965         | 133,537                 | 85                        | 29.5                                   | 68.6                                   | 61.1  | 133                        | 73                                    |
| Levy Co.        | 21,708          | 40,276          | 18,568                  | 86                        | 22.2                                   | 42.2                                   | 31.3  | 90                         | 96                                    |
| Liberty Co.     | 4,434           | 8,236           | 3,802                   | 86                        | 2.1                                    | 3.4                                    | 2.0   | 62                         | 100                                   |
| Madison Co.     | 15,262          | 18,474          | 3,212                   | 21                        | 6.7                                    | 12.2                                   | 8.6   | 82                         | 32                                    |
| Manatee Co.     | 163,625         | 385,506         | 221,881                 | 136                       | 51.3                                   | 107.4                                  | 87.7  | 109                        | 100                                   |
| Marion Co.      | 137,381         | 353,339         | 215,958                 | 157                       | 116.5                                  | 228.8                                  | 175.5   | 96                         | 100                                   |
| Martin Co.      | 72,508          | 159,701         | 87,193                  | 120                       | 36.1                                   | 61.3                                   | 39.4  | 70                         | 100                                   |
| Miami-Dade Co.* | 1,727,093       | 2,713,295       | 986,202                 | 57                        | 188.9                                  | 264.0                                  | 117.3   | 40                         | 100                                   |
| Monroe Co.      | 66,797          | 76,483          | 9,686                   | 15                        | 18.2                                   | 29.9                                   | 18.3  | 64                         | 27                                    |
| Nassau Co.      | 34,772          | 82,925          | 48,153                  | 138                       | 37.0                                   | 64.8                                   | 43.4  | 75                         | 100                                   |
| Okaloosa Co.    | 116,608         | 203,478         | 86,870                  | 74                        | 29.9                                   | 81.0                                   | 79.8  | 171                        | 56                                    |
| Okeechobee Co.  | 23,015          | 41,275          | 18,260                  | 79                        | 23.8                                   | 44.2                                   | 31.9  | 86                         | 94                                    |

| <b>Florida County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Orange Co.            | 505,072                | 1,355,921              | 850,849                        | 168                              | 83.8  | 238.7   | 242.0  | 185                               | 94   |
| Osceola Co.           | 60,329                 | 353,623                | 293,294                        | 486                              | 34.3  | 114.5   | 125.3  | 234                               | 100  |
| Palm Beach Co.        | 645,890                | 1,470,344              | 824,454                        | 128                              | 183.2   | 304.2   | 189.1  | 66                                | 100  |
| Pasco Co.             | 217,303                | 525,141                | 307,838                        | 142                              | 58.1  | 128.2   | 109.5  | 121                               | 100  |
| Pinellas Co.          | 761,982                | 968,341                | 206,359                        | 27                               | 107.4   | 145.9   | 60.2   | 36                                | 78   |
| Polk Co.              | 339,930                | 685,368                | 345,438                        | 102                              | 104.9   | 246.7   | 221.6  | 135                               | 82   |
| Putnam Co.            | 53,613                 | 73,384                 | 19,771                         | 37                               | 25.4  | 54.2  | 45.0   | 113                               | 41   |
| St. Johns Co.         | 56,861                 | 243,693                | 186,832                        | 329                              | 35.0  | 82.5  | 74.2   | 136                               | 100  |
| St. Lucie Co.         | 101,092                | 313,163                | 212,071                        | 210                              | 57.4  | 84.4  | 42.2   | 47                                | 100  |
| Santa Rosa Co.        | 60,595                 | 174,049                | 113,454                        | 187                              | 26.6  | 95.2  | 107.2  | 258                               | 83   |
| Sarasota Co.          | 221,098                | 419,680                | 198,582                        | 90                               | 76.3  | 131.0   | 85.5   | 72                                | 100  |
| Seminole Co.          | 198,477                | 462,801                | 264,324                        | 133                              | 44.1  | 99.7  | 86.9   | 126                               | 100  |

| Florida County          | 1982 Population   | 2017 Population   | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-------------------|-------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Sumter Co.              | 25,822            | 124,995           | 99,173                  | 384                       | 13.7                                   | 36.0                                   | 34.8  | 163                        | 100                                   |
| Suwannee Co.            | 23,619            | 44,124            | 20,505                  | 87                        | 18.0                                   | 33.9                                   | 24.8  | 88                         | 99                                    |
| Taylor Co.              | 16,972            | 21,781            | 4,809                   | 28                        | 21.9                                   | 29.3                                   | 11.6  | 34                         | 86                                    |
| Union Co.               | 10,961            | 15,448            | 4,487                   | 41                        | 5.4                                    | 10.6                                   | 8.1   | 96                         | 51                                    |
| Volusia Co.             | 281,884           | 537,868           | 255,984                 | 91                        | 75.8                                   | 132.1                                  | 88.0  | 74                         | 100                                   |
| Wakulla Co.             | 11,218            | 32,050            | 20,832                  | 186                       | 7.3                                    | 21.7                                   | 22.5  | 197                        | 96                                    |
| Walton Co.              | 22,668            | 68,021            | 45,353                  | 200                       | 34.1                                   | 57.9                                   | 37.2  | 70                         | 100                                   |
| Washington Co.          | 15,112            | 24,546            | 9,434                   | 62                        | 13.9                                   | 45.4                                   | 49.2  | 227                        | 41                                    |
| <b>Totals</b>           | <b>10,471,405</b> | <b>20,963,613</b> | <b>10,492,208</b>       | <b>100</b>                | <b>2,814.4</b>                         | <b>5,600.3</b>                         | <b>4,353.0</b>                                    | <b>99</b>                  | <b>100</b>                            |
| <b>Weighted Average</b> |                   |                   |                         |                           |  |  |   |                            | <b>89</b>                             |



**Scatter Plot for Florida County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.85**

**Georgia**

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Appling Co.           | 15,601                 | 18,438                 | 2,837                          | 18                               | 11.1  | 20.7  | 15.0   | 86                                | 27   |
| Atkinson Co.          | 6,177                  | 8,182                  | 2,005                          | 32                               | 3.9   | 6.9   | 4.7  | 77                                | 49   |
| Bacon Co.             | 9,577                  | 11,205                 | 1,628                          | 17                               | 4.5   | 11.0  | 10.2   | 144                               | 18   |
| Baker Co.             | 3,916                  | 3,159                  | -757                           | -19                              | 3.4   | 4.2   | 1.3  | 24                                | 0  |
| Baldwin Co.           | 36,758                 | 44,963                 | 8,205                          | 22                               | 14.4  | 35.2  | 32.5   | 144                               | 23   |
| Banks Co.             | 8,927                  | 18,628                 | 9,701                          | 109                              | 6.0   | 16.3  | 16.1   | 172                               | 74   |
| Barrow Co.            | 22,371                 | 78,899                 | 56,528                         | 253                              | 12.2  | 31.2  | 29.7   | 156                               | 100  |
| Bartow Co.            | 42,427                 | 105,098                | 62,671                         | 148                              | 21.1  | 48.4  | 42.7   | 129                               | 100  |
| Ben Hill Co.          | 16,361                 | 17,037                 | 676                            | 4                                | 5.0   | 15.0  | 15.6   | 200                               | 4  |
| Berrien Co.           | 13,798                 | 19,108                 | 5,310                          | 38                               | 4.3   | 13.3  | 14.1   | 209                               | 29   |
| Bibb Co.              | 151,671                | 152,840                | 1,169                          | 1                                | 28.8  | 69.0  | 62.8   | 140                               | 1  |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Bleckley Co.          | 10,776                 | 12,764                 | 1,988                          | 18                               | 4.0   | 8.0   | 6.3  | 100                               | 24   |
| Brantley Co.          | 9,191                  | 18,832                 | 9,641                          | 105                              | 7.5   | 17.7  | 15.9   | 136                               | 84   |
| Brooks Co.            | 15,455                 | 15,617                 | 162                            | 1                                | 4.4   | 10.5  | 9.5  | 139                               | 1  |
| Bryan Co.             | 10,569                 | 36,999                 | 26,430                         | 250                              | 6.5   | 19.9  | 20.9   | 206                               | 100  |
| Bulloch Co.           | 37,277                 | 75,991                 | 38,714                         | 104                              | 13.7  | 37.3  | 36.9   | 172                               | 71   |
| Burke Co.             | 19,912                 | 22,545                 | 2,633                          | 13                               | 10.4  | 15.9  | 8.6  | 53                                | 29   |
| Butts Co.             | 14,598                 | 24,067                 | 9,469                          | 65                               | 6.0   | 14.5  | 13.3   | 142                               | 57   |
| Calhoun Co.           | 5,672                  | 6,389                  | 717                            | 13                               | 3.1   | 5.4   | 3.6  | 74                                | 21   |
| Camden Co.            | 16,093                 | 53,005                 | 36,912                         | 229                              | 13.9  | 26.4  | 19.5   | 90                                | 100  |
| Candler Co.           | 7,610                  | 10,706                 | 3,096                          | 41                               | 5.1   | 11.0  | 9.2  | 116                               | 44   |
| Carroll Co.           | 59,634                 | 117,390                | 57,756                         | 97                               | 39.9  | 68.0  | 43.9   | 70                                | 100  |
| Catoosa Co.           | 37,943                 | 66,495                 | 28,552                         | 75                               | 11.3  | 36.3  | 39.1   | 221                               | 48   |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Charlton Co.          | 7,554                  | 12,810                 | 5,256                          | 70                               | 4.2   | 5.2   | 1.6  | 24                                | 100  |
| Chatham Co.           | 209,224                | 289,309                | 80,085                         | 38                               | 56.9  | 98.2  | 64.5   | 73                                | 59   |
| Chattahoochee Co.     | 21,329                 | 10,205                 | -11,124                        | -52                              | 1.6   | 5.5   | 6.1  | 244                               | 0  |
| Chattooga Co.         | 21,732                 | 24,746                 | 3,014                          | 14                               | 16.2  | 23.9  | 12.0   | 48                                | 33   |
| Cherokee Co.          | 56,171                 | 247,763                | 191,592                        | 341                              | 14.7  | 111.2   | 150.8  | 656                               | 73   |
| Clarke Co.            | 77,682                 | 126,815                | 49,133                         | 63                               | 22.1  | 38.1  | 25.0   | 72                                | 90   |
| Clay Co.              | 3,526                  | 2,955                  | -571                           | -16                              | 2.5   | 3.6   | 1.7  | 44                                | 0  |
| Clayton Co.           | 155,788                | 284,184                | 128,396                        | 82                               | 39.1  | 64.8  | 40.2   | 66                                | 100  |
| Clinch Co.            | 6,599                  | 6,643                  | 44                             | 1                                | 11.1  | 16.5  | 8.4  | 49                                | 2  |
| Cobb Co.              | 321,994                | 752,649                | 430,655                        | 134                              | 112.9   | 181.2   | 106.7  | 60                                | 100  |
| Coffee Co.            | 27,360                 | 42,880                 | 15,520                         | 57                               | 18.3  | 37.9  | 30.6   | 107                               | 62   |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Colquitt Co.          | 36,205                 | 45,480                 | 9,275                          | 26                               | 15.1  | 25.9  | 16.9   | 72                                | 42   |
| Columbia Co.          | 43,509                 | 151,529                | 108,020                        | 248                              | 23.9  | 53.0  | 45.5   | 122                               | 100  |
| Cook Co.              | 13,651                 | 17,213                 | 3,562                          | 26                               | 7.9   | 12.6  | 7.3  | 59                                | 50   |
| Coweta Co.            | 40,933                 | 143,153                | 102,220                        | 250                              | 27.0  | 79.3  | 81.7   | 194                               | 100  |
| Crawford Co.          | 7,393                  | 12,263                 | 4,870                          | 66                               | 3.7   | 12.8  | 14.2   | 246                               | 41   |
| Crisp Co.             | 19,994                 | 22,710                 | 2,716                          | 14                               | 12.4  | 22.0  | 15.0   | 77                                | 22   |
| Dade Co.              | 12,207                 | 16,254                 | 4,047                          | 33                               | 9.7   | 18.2  | 13.3   | 88                                | 45   |
| Dawson Co.            | 5,261                  | 24,406                 | 19,145                         | 364                              | 5.1   | 12.8  | 12.0   | 151                               | 100  |
| Decatur Co.           | 25,899                 | 26,706                 | 807                            | 3                                | 14.8  | 22.1  | 11.4   | 49                                | 8  |
| DeKalb Co.            | 492,317                | 751,176                | 258,859                        | 53                               | 93.9  | 140.3   | 72.5   | 49                                | 100  |
| Dodge Co.             | 17,063                 | 20,749                 | 3,686                          | 22                               | 5.7   | 15.2  | 14.8   | 167                               | 20   |
| Dooly Co.             | 10,714                 | 13,691                 | 2,977                          | 28                               | 9.7   | 12.4  | 4.2  | 28                                | 100  |

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|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Dougherty Co.         | 102,359                | 89,457                 | -12,902                        | -13                              | 32.7  | 48.6  | 24.8   | 49                                | 0  |
| Douglas Co.           | 57,293                 | 143,376                | 86,083                         | 150                              | 31.1  | 56.2  | 39.2   | 81                                | 100  |
| Early Co.             | 13,051                 | 10,317                 | -2,734                         | -21                              | 7.5   | 10.6  | 4.8  | 41                                | 0  |
| Echols Co.            | 2,177                  | 3,914                  | 1,737                          | 80                               | 4.3   | 5.0   | 1.1  | 16                                | 100  |
| Effingham Co.         | 19,321                 | 60,086                 | 40,765                         | 211                              | 9.1   | 25.8  | 26.1   | 184                               | 100  |
| Elbert Co.            | 18,991                 | 19,102                 | 111                            | 1                                | 3.2   | 9.2   | 9.4  | 188                               | 1  |
| Emanuel Co.           | 20,885                 | 22,533                 | 1,648                          | 8                                | 10.2  | 18.1  | 12.3   | 77                                | 13   |
| Evans Co.             | 8,546                  | 10,741                 | 2,195                          | 26                               | 5.2   | 8.5   | 5.2  | 63                                | 47   |
| Fannin Co.            | 14,899                 | 25,332                 | 10,433                         | 70                               | 8.2   | 23.2  | 23.4   | 183                               | 51   |
| Fayette Co.           | 33,701                 | 112,553                | 78,852                         | 234                              | 29.3  | 59.1  | 46.6   | 102                               | 100  |
| Floyd Co.             | 79,897                 | 97,500                 | 17,603                         | 22                               | 34.0  | 57.6  | 36.9   | 69                                | 38   |
| Forsyth Co.           | 29,596                 | 228,940                | 199,344                        | 674                              | 21.5  | 79.1  | 90.0   | 268                               | 100  |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Franklin Co.          | 15,495                 | 22,864                 | 7,369                          | 48                               | 7.4   | 18.5  | 17.3   | 150                               | 42   |
| Fulton Co.            | 607,085                | 1,038,938              | 431,853                        | 71                               | 146.0   | 235.3   | 139.5  | 61                                | 100  |
| Gilmer Co.            | 11,413                 | 30,443                 | 19,030                         | 167                              | 5.2   | 23.1  | 28.0   | 344                               | 66   |
| Glascock Co.          | 2,407                  | 3,032                  | 625                            | 26                               | 1.6   | 3.6   | 3.1  | 125                               | 28   |
| Glynn Co.             | 56,270                 | 84,675                 | 28,405                         | 50                               | 31.2  | 51.8  | 32.2   | 66                                | 81   |
| Gordon Co.            | 30,752                 | 57,164                 | 26,412                         | 86                               | 15.8  | 40.7  | 38.9   | 158                               | 66   |
| Grady Co.             | 19,782                 | 24,773                 | 4,991                          | 25                               | 14.9  | 22.0  | 11.1   | 48                                | 58   |
| Greene Co.            | 11,512                 | 17,203                 | 5,691                          | 49                               | 6.2   | 14.3  | 12.7   | 131                               | 48   |
| Gwinnett Co.          | 192,057                | 918,186                | 726,129                        | 378                              | 70.4  | 214.0   | 224.4  | 204                               | 100  |
| Habersham Co.         | 25,810                 | 44,535                 | 18,725                         | 73                               | 6.6   | 29.1  | 35.2   | 341                               | 37   |
| Hall Co.              | 78,832                 | 198,953                | 120,121                        | 152                              | 49.1  | 94.5  | 70.9   | 92                                | 100  |
| Hancock Co.           | 9,379                  | 8,539                  | -840                           | -9                               | 6.3   | 10.9  | 7.2  | 73                                | 0  |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Haralson Co.          | 19,241                 | 29,248                 | 10,007                         | 52                               | 14.1  | 25.1  | 17.2   | 78                                | 73   |
| Harris Co.            | 15,356                 | 33,943                 | 18,587                         | 121                              | 11.9  | 28.7  | 26.3   | 141                               | 90   |
| Hart Co.              | 18,863                 | 25,710                 | 6,847                          | 36                               | 9.8   | 22.8  | 20.3   | 133                               | 37   |
| Heard Co.             | 6,648                  | 11,751                 | 5,103                          | 77                               | 4.3   | 7.1   | 4.4  | 65                                | 100  |
| Henry Co.             | 38,270                 | 225,182                | 186,912                        | 488                              | 14.4  | 88.1  | 115.2  | 512                               | 98   |
| Houston Co.           | 80,598                 | 153,202                | 72,604                         | 90                               | 26.0  | 69.5  | 68.0   | 167                               | 65   |
| Irwin Co.             | 8,892                  | 9,352                  | 460                            | 5                                | 5.0   | 6.8   | 2.8  | 36                                | 16   |
| Jackson Co.           | 26,228                 | 67,644                 | 41,416                         | 158                              | 12.3  | 44.1  | 49.7   | 259                               | 74   |
| Jasper Co.            | 7,486                  | 13,882                 | 6,396                          | 85                               | 6.1   | 10.5  | 6.9  | 72                                | 100  |
| Jeff Davis Co.        | 11,736                 | 15,039                 | 3,303                          | 28                               | 5.3   | 10.7  | 8.4  | 102                               | 35   |
| Jefferson Co.         | 18,362                 | 15,630                 | -2,732                         | -15                              | 10.6  | 18.0  | 11.6   | 70                                | 0  |
| Jenkins Co.           | 8,719                  | 8,813                  | 94                             | 1                                | 7.4   | 10.2  | 4.4  | 38                                | 3  |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Johnson Co.           | 8,635                  | 9,737                  | 1,102                          | 13                               | 6.1   | 10.9  | 7.5  | 79                                | 21   |
| Jones Co.             | 17,540                 | 28,466                 | 10,926                         | 62                               | 11.7  | 20.5  | 13.8   | 75                                | 86   |
| Lamar Co.             | 12,041                 | 18,600                 | 6,559                          | 54                               | 3.9   | 11.4  | 11.7   | 192                               | 41   |
| Lanier Co.            | 5,716                  | 10,425                 | 4,709                          | 82                               | 4.7   | 9.6   | 7.7  | 104                               | 84   |
| Laurens Co.           | 37,830                 | 47,376                 | 9,546                          | 25                               | 23.4  | 42.3  | 29.5   | 81                                | 38   |
| Lee Co.               | 12,837                 | 29,410                 | 16,573                         | 129                              | 7.7   | 18.8  | 17.3   | 144                               | 93   |
| Liberty Co.           | 43,543                 | 61,619                 | 18,076                         | 42                               | 23.3  | 34.5  | 17.5   | 48                                | 88   |
| Lincoln Co.           | 6,731                  | 7,856                  | 1,125                          | 17                               | 4.3   | 7.6   | 5.2  | 77                                | 27   |
| Long Co.              | 5,018                  | 18,780                 | 13,762                         | 274                              | 7.1   | 14.0  | 10.8   | 97                                | 100  |
| Lowndes Co.           | 69,473                 | 115,404                | 45,931                         | 66                               | 32.9  | 57.6  | 38.6   | 75                                | 91   |
| Lumpkin Co.           | 11,364                 | 32,801                 | 21,437                         | 189                              | 4.4   | 15.9  | 18.0   | 261                               | 83   |
| McDuffie Co.          | 18,810                 | 21,511                 | 2,701                          | 14                               | 10.1  | 20.3  | 15.9   | 101                               | 19   |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| McIntosh Co.          | 8,166                  | 14,080                 | 5,914                          | 72                               | 9.3   | 16.4  | 11.1   | 76                                | 96   |
| Macon Co.             | 13,958                 | 13,254                 | -704                           | -5                               | 7.4   | 11.4  | 6.3  | 54                                | 0  |
| Madison Co.           | 18,240                 | 29,295                 | 11,055                         | 61                               | 6.3   | 17.3  | 17.2   | 175                               | 47   |
| Marion Co.            | 5,338                  | 8,403                  | 3,065                          | 57                               | 4.2   | 9.6   | 8.4  | 129                               | 55   |
| Meriwether Co.        | 21,277                 | 21,021                 | -256                           | -1                               | 18.9  | 32.9  | 21.9   | 74                                | 0  |
| Miller Co.            | 6,915                  | 5,813                  | -1,102                         | -16                              | 2.7   | 4.1   | 2.2  | 52                                | 0  |
| Mitchell Co.          | 21,258                 | 22,317                 | 1,059                          | 5                                | 6.8   | 13.9  | 11.1   | 104                               | 7  |
| Monroe Co.            | 14,865                 | 27,163                 | 12,298                         | 83                               | 7.2   | 24.7  | 27.3   | 243                               | 49   |
| Montgomery Co.        | 7,011                  | 9,024                  | 2,013                          | 29                               | 3.3   | 5.5   | 3.4  | 67                                | 49   |
| Morgan Co.            | 11,995                 | 18,373                 | 6,378                          | 53                               | 11.8  | 19.7  | 12.3   | 67                                | 83   |
| Murray Co.            | 20,856                 | 39,803                 | 18,947                         | 91                               | 6.4   | 28.5  | 34.5   | 345                               | 43   |
| Muscogee Co.          | 174,633                | 193,836                | 19,203                         | 11                               | 26.3  | 46.2  | 31.1   | 76                                | 19   |

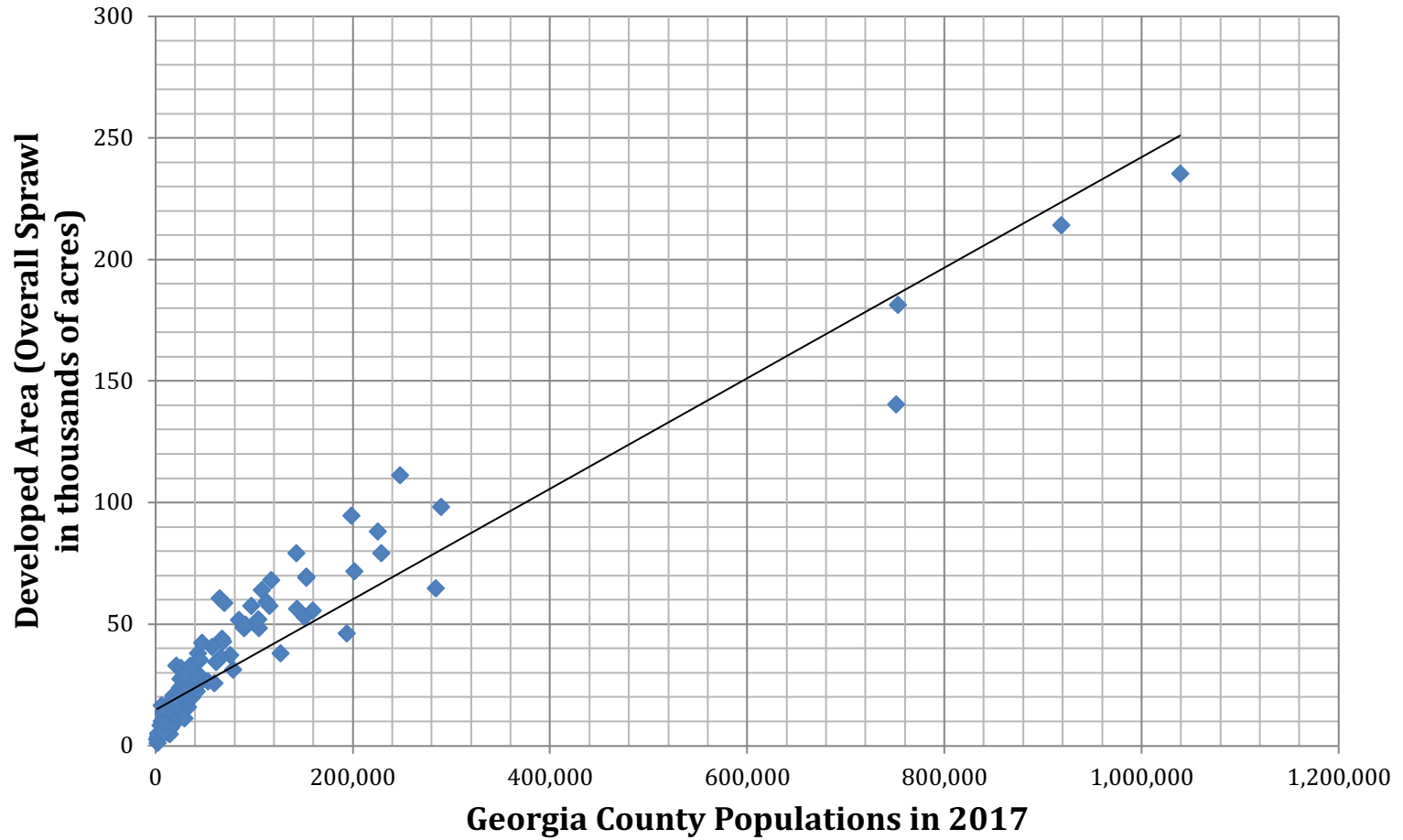
| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Newton Co.            | 36,771                 | 107,846                | 71,075                         | 193                              | 23.9  | 63.9  | 62.5   | 167                               | 100  |
| Oconee Co.            | 13,282                 | 38,122                 | 24,840                         | 187                              | 5.8   | 20.6  | 23.1   | 255                               | 83   |
| Oglethorpe Co.        | 9,085                  | 14,874                 | 5,789                          | 64                               | 3.9   | 4.8   | 1.4  | 23                                | 100  |
| Paulding Co.          | 27,800                 | 159,509                | 131,709                        | 474                              | 6.5   | 55.5  | 76.6   | 754                               | 81   |
| Peach Co.             | 18,607                 | 26,961                 | 8,354                          | 45                               | 6.5   | 19.0  | 19.5   | 192                               | 35   |
| Pickens Co.           | 12,079                 | 31,541                 | 19,462                         | 161                              | 6.3   | 22.5  | 25.3   | 257                               | 75   |
| Pierce Co.            | 12,321                 | 19,197                 | 6,876                          | 56                               | 9.0   | 20.4  | 17.8   | 127                               | 54   |
| Pike Co.              | 9,005                  | 18,204                 | 9,199                          | 102                              | 5.0   | 20.1  | 23.6   | 302                               | 51   |
| Polk Co.              | 32,868                 | 41,818                 | 8,950                          | 27                               | 13.9  | 22.3  | 13.1   | 60                                | 51   |
| Pulaski Co.           | 8,879                  | 11,181                 | 2,302                          | 26                               | 3.5   | 7.5   | 6.3  | 114                               | 30   |
| Putnam Co.            | 10,817                 | 21,692                 | 10,875                         | 101                              | 5.8   | 22.0  | 25.3   | 279                               | 52   |
| Quitman Co.           | 2,309                  | 2,333                  | 24                             | 1                                | 1.1   | 1.2   | 0.2  | 9                                 | 12   |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Rabun Co.             | 10,683                 | 16,545                 | 5,862                          | 55                               | 6.0   | 12.0  | 9.4  | 100                               | 63   |
| Randolph Co.          | 9,480                  | 6,969                  | -2,511                         | -26                              | 9.0   | 9.8   | 1.3  | 9                                 | 0  |
| Richmond Co.          | 183,190                | 201,673                | 18,483                         | 10                               | 44.5  | 71.8  | 42.7   | 61                                | 20   |
| Rockdale Co.          | 38,639                 | 89,843                 | 51,204                         | 133                              | 18.6  | 48.4  | 46.6   | 160                               | 88   |
| Schley Co.            | 3,461                  | 5,235                  | 1,774                          | 51                               | 1.4   | 4.9   | 5.5  | 250                               | 33   |
| Screven Co.           | 14,068                 | 13,956                 | -112                           | -1                               | 11.6  | 16.5  | 7.7  | 42                                | 0  |
| Seminole Co.          | 9,011                  | 8,253                  | -758                           | -8                               | 4.6   | 9.4   | 7.5  | 104                               | 0  |
| Spalding Co.          | 49,564                 | 65,358                 | 15,794                         | 32                               | 24.3  | 60.6  | 56.7   | 149                               | 30   |
| Stephens Co.          | 22,051                 | 25,736                 | 3,685                          | 17                               | 8.3   | 19.9  | 18.1   | 140                               | 18   |
| Stewart Co.           | 5,905                  | 6,314                  | 409                            | 7                                | 4.3   | 4.4   | 0.2  | 2                                 | 100  |
| Sumter Co.            | 30,338                 | 29,901                 | -437                           | -1                               | 16.1  | 22.6  | 10.2   | 40                                | 0  |
| Talbot Co.            | 6,605                  | 6,256                  | -349                           | -5                               | 6.5   | 10.0  | 5.5  | 54                                | 0  |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Taliaferro Co.        | 2,063                  | 1,613                  | -450                           | -22                              | 2.3   | 2.5   | 0.3  | 9                                 | 0  |
| Tattnall Co.          | 17,522                 | 25,409                 | 7,887                          | 45                               | 9.1   | 27.4  | 28.6   | 201                               | 34   |
| Taylor Co.            | 7,853                  | 8,110                  | 257                            | 3                                | 6.7   | 13.1  | 10.0   | 96                                | 5  |
| Telfair Co.           | 11,488                 | 15,929                 | 4,441                          | 39                               | 4.5   | 7.5   | 4.7  | 67                                | 64   |
| Terrell Co.           | 11,919                 | 8,695                  | -3,224                         | -27                              | 5.2   | 11.1  | 9.2  | 113                               | 0  |
| Thomas Co.            | 38,844                 | 44,619                 | 5,775                          | 15                               | 15.8  | 35.7  | 31.1   | 126                               | 17   |
| Tift Co.              | 33,809                 | 40,431                 | 6,622                          | 20                               | 16.1  | 28.6  | 19.5   | 78                                | 31   |
| Toombs Co.            | 23,015                 | 26,859                 | 3,844                          | 17                               | 5.8   | 28.2  | 35.0   | 386                               | 10   |
| Towns Co.             | 6,039                  | 11,553                 | 5,514                          | 91                               | 5.0   | 13.4  | 13.1   | 168                               | 66   |
| Treutlen Co.          | 6,190                  | 6,746                  | 556                            | 9                                | 3.0   | 5.6   | 4.1  | 87                                | 14   |
| Troup Co.             | 51,196                 | 70,062                 | 18,866                         | 37                               | 35.4  | 58.7  | 36.4   | 66                                | 62   |
| Turner Co.            | 9,461                  | 7,895                  | -1,566                         | -17                              | 7.1   | 10.4  | 5.2  | 46                                | 0  |

| <b>Georgia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Twiggs Co.            | 9,416                  | 8,253                  | -1,163                         | -12                              | 7.5   | 14.0  | 10.2   | 87                                | 0  |
| Union Co.             | 9,857                  | 23,376                 | 13,519                         | 137                              | 5.0   | 21.0  | 25.0   | 320                               | 60   |
| Upson Co.             | 26,530                 | 26,201                 | -329                           | -1                               | 11.3  | 32.0  | 32.3   | 183                               | 0  |
| Walker Co.            | 57,173                 | 68,999                 | 11,826                         | 21                               | 30.3  | 42.9  | 19.7   | 42                                | 54   |
| Walton Co.            | 31,576                 | 91,296                 | 59,720                         | 189                              | 16.8  | 49.8  | 51.6   | 196                               | 98   |
| Ware Co.              | 37,375                 | 35,668                 | -1,707                         | -5                               | 13.6  | 32.9  | 30.2   | 142                               | 0  |
| Warren Co.            | 6,621                  | 5,265                  | -1,356                         | -20                              | 5.6   | 8.3   | 4.2  | 48                                | 0  |
| Washington Co.        | 18,964                 | 20,311                 | 1,347                          | 7                                | 9.5   | 16.1  | 10.3   | 69                                | 13   |
| Wayne Co.             | 21,509                 | 29,797                 | 8,288                          | 39                               | 10.5  | 29.3  | 29.4   | 179                               | 32   |
| Webster Co.           | 2,384                  | 2,589                  | 205                            | 9                                | 3.6   | 5.0   | 2.2  | 39                                | 25   |
| Wheeler Co.           | 5,159                  | 7,960                  | 2,801                          | 54                               | 4.4   | 6.0   | 2.5  | 36                                | 100  |
| White Co.             | 10,615                 | 29,445                 | 18,830                         | 177                              | 3.0   | 11.4  | 13.1   | 280                               | 76   |

| <b>Georgia County</b>   | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Whitfield Co.           | 66,321                 | 104,234                | 37,913                         | 57                               | 12.0  | 52.0  | 62.5   | 333                               | 31   |
| Wilcox Co.              | 7,552                  | 8,791                  | 1,239                          | 16                               | 5.3   | 5.4   | 0.2  | 2                                 | 100  |
| Wilkes Co.              | 11,140                 | 9,860                  | -1,280                         | -11                              | 5.7   | 14.4  | 13.6   | 153                               | 0  |
| Wilkinson Co.           | 10,372                 | 8,954                  | -1,418                         | -14                              | 5.6   | 9.1   | 5.5  | 63                                | 0  |
| Worth Co.               | 18,629                 | 20,528                 | 1,899                          | 10                               | 11.6  | 18.9  | 11.4   | 63                                | 20   |
| <b>Totals</b>           | <b>5,649,788</b>       | <b>10,410,330</b>      | <b>4,760,542</b>               | <b>84</b>                        | <b>2,227.1</b>                                | <b>4,729.6</b>                                | <b>3,910.2</b>   | <b>112</b>                        | <b>81</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>65</b>                                    |

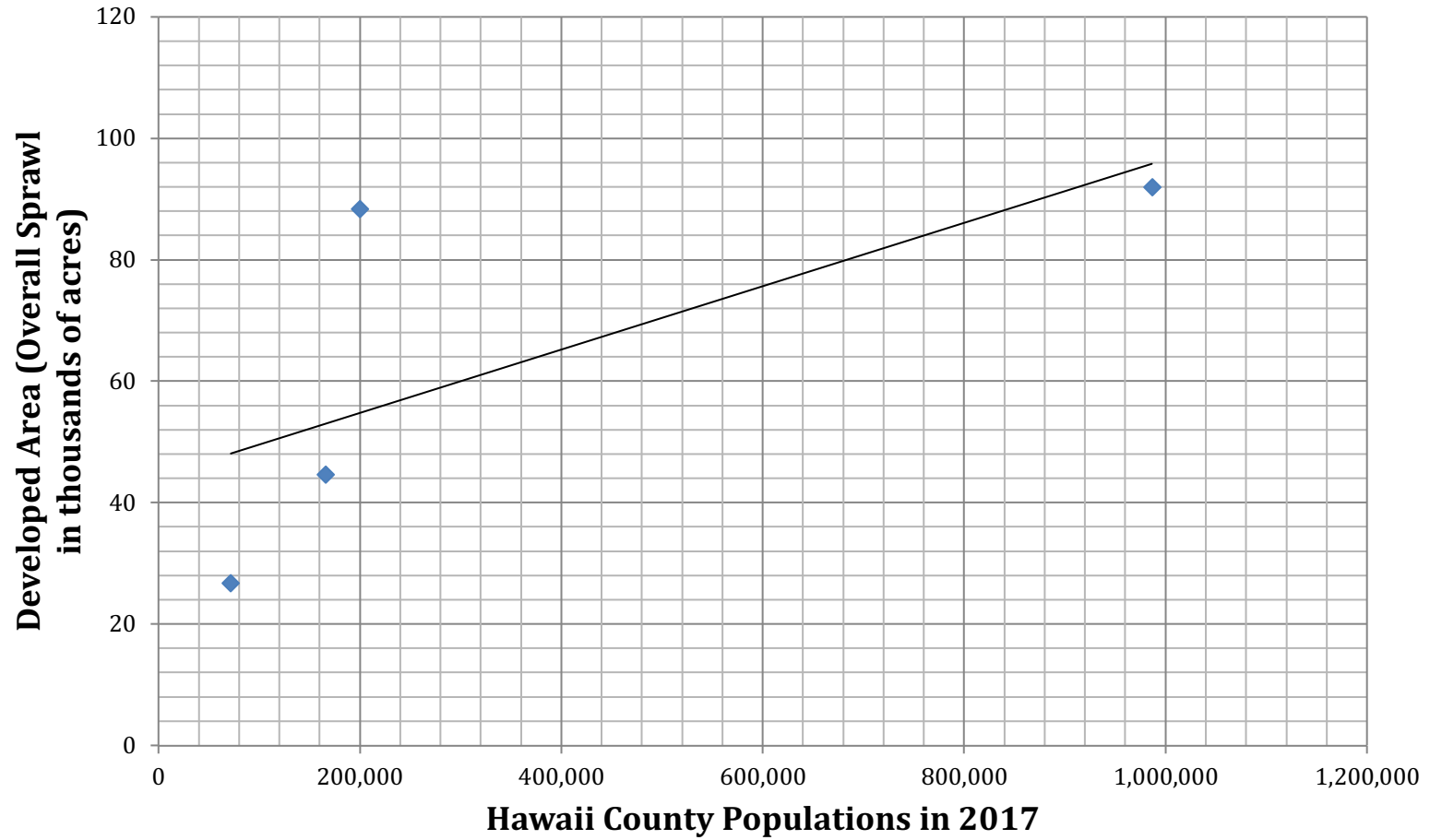


**Scatter Plot for Georgia County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.94**

**Hawaii**

| <b>Hawaii County</b>    | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Hawaii Co.              | 98,798                 | 199,981                | 101,183                        | 102                              | 58.0  | 88.4  | 47.5   | 52                                | 100  |
| Honolulu Co.            | 776,075                | 986,353                | 210,278                        | 27                               | 67.4  | 92.0  | 38.4   | 36                                | 77   |
| Kalawao Co.             | 133                    | 86                     | -47                            | -35                              | 0.0   | 0.0   | 0.0  | N/A                               | N/A  |
| Kauai Co.               | 41,804                 | 71,827                 | 30,023                         | 72                               | 15.2  | 26.8  | 18.1   | 76                                | 95   |
| Maui Co.                | 76,970                 | 166,146                | 89,176                         | 116                              | 24.0  | 44.6  | 32.2   | 86                                | 100  |
| <b>Totals</b>           | <b>993,780</b>         | <b>1,424,393</b>       | <b>430,613</b>                 | <b>43</b>                        | <b>164.6</b>                                  | <b>251.8</b>                                  | <b>136.3</b>   | <b>53</b>                         | <b>85</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>93</b>                                    |



**Scatter Plot for Hawaii County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.68**

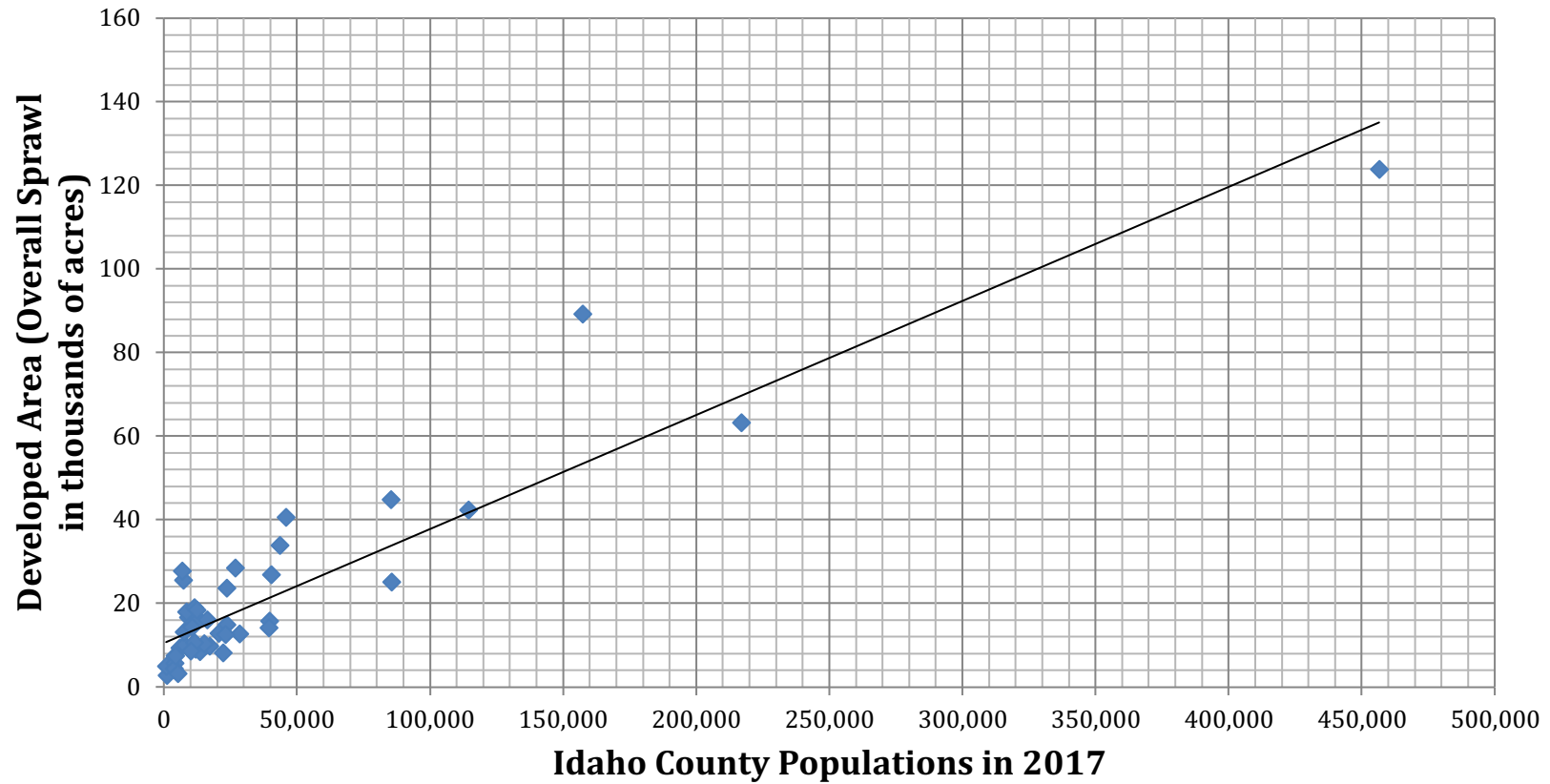
**Idaho**

| <b>Idaho County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Ada Co.             | 180,481                | 456,548                | 276,067                        | 153                              | 49.9  | 123.8   | 115.5  | 148                               | 100  |
| Adams Co.           | 3,237                  | 4,127                  | 890                            | 27                               | 6.1   | 7.4   | 2.0  | 21                                | 100  |
| Bannock Co.         | 67,081                 | 85,482                 | 18,401                         | 27                               | 17.9  | 25.1  | 11.3   | 40                                | 72   |
| Bear Lake Co.       | 7,385                  | 6,023                  | -1,362                         | -18                              | 7.7   | 9.3   | 2.5  | 21                                | 0  |
| Benewah Co.         | 8,378                  | 9,157                  | 779                            | 9                                | 7.8   | 16.6  | 13.8   | 113                               | 12   |
| Bingham Co.         | 37,516                 | 45,884                 | 8,368                          | 22                               | 24.9  | 40.6  | 24.5   | 63                                | 41   |
| Blaine Co.          | 11,256                 | 22,373                 | 11,117                         | 99                               | 4.0   | 8.1   | 6.4  | 103                               | 97   |
| Boise Co.           | 3,059                  | 7,347                  | 4,288                          | 140                              | 5.7   | 25.5  | 30.9   | 347                               | 58   |
| Bonner Co.          | 25,137                 | 43,654                 | 18,517                         | 74                               | 17.3  | 33.9  | 25.9   | 96                                | 82   |
| Bonneville Co.      | 66,865                 | 114,488                | 47,623                         | 71                               | 27.8  | 42.3  | 22.7   | 52                                | 100  |
| Boundary Co.        | 7,458                  | 11,965                 | 4,507                          | 60                               | 7.5   | 9.1   | 2.5  | 21                                | 100  |

| <b>Idaho County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Butte Co.           | 3,490                  | 2,585                  | -905                           | -26                              | 2.7   | 4.0   | 2.0  | 48                                | 0  |
| Camas Co.           | 804                    | 1,096                  | 292                            | 36                               | 2.8   | 2.7   | -0.2   | -4                                | 0  |
| Canyon Co.          | 85,537                 | 216,858                | 131,321                        | 154                              | 28.2  | 63.2  | 54.7   | 124                               | 100  |
| Caribou Co.         | 8,873                  | 6,973                  | -1,900                         | -21                              | 10.2  | 27.7  | 27.3   | 172                               | 0  |
| Cassia Co.          | 20,066                 | 23,650                 | 3,584                          | 18                               | 18.8  | 23.7  | 7.7  | 26                                | 71   |
| Clark Co.           | 831                    | 879                    | 48                             | 6                                | 4.5   | 4.9   | 0.6  | 9                                 | 66   |
| Clearwater Co.      | 10,333                 | 8,646                  | -1,687                         | -16                              | 14.6  | 18.0  | 5.3  | 23                                | 0  |
| Custer Co.          | 5,031                  | 4,135                  | -896                           | -18                              | 4.8   | 5.7   | 1.4  | 19                                | 0  |
| Elmore Co.          | 21,849                 | 26,881                 | 5,032                          | 23                               | 18.8  | 28.5  | 15.2   | 52                                | 50   |
| Franklin Co.        | 9,465                  | 13,467                 | 4,002                          | 42                               | 5.4   | 8.5   | 4.8  | 57                                | 78   |
| Fremont Co.         | 11,080                 | 13,122                 | 2,042                          | 18                               | 14.0  | 16.0  | 3.1  | 14                                | 100  |
| Gem Co.             | 11,787                 | 17,311                 | 5,524                          | 47                               | 5.6   | 9.8   | 6.6  | 75                                | 69   |

| <b>Idaho County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Gooding Co.         | 12,402                 | 15,121                 | 2,719                          | 22                               | 7.4   | 10.3  | 4.5  | 39                                | 60   |
| Idaho Co.           | 14,865                 | 16,373                 | 1,508                          | 10                               | 16.5  | 16.0  | -0.8   | -3                                | 0  |
| Jefferson Co.       | 15,596                 | 28,439                 | 12,843                         | 82                               | 9.7   | 12.7  | 4.7  | 31                                | 100  |
| Jerome Co.          | 15,699                 | 23,768                 | 8,069                          | 51                               | 9.0   | 14.9  | 9.2  | 66                                | 82   |
| Kootenai Co.        | 62,436                 | 157,320                | 94,884                         | 152                              | 49.9  | 89.2  | 61.4   | 79                                | 100  |
| Latah Co.           | 29,908                 | 39,741                 | 9,833                          | 33                               | 12.1  | 15.7  | 5.6  | 30                                | 100  |
| Lemhi Co.           | 8,036                  | 7,829                  | -207                           | -3                               | 8.4   | 10.0  | 2.5  | 19                                | 0  |
| Lewis Co.           | 4,056                  | 3,884                  | -172                           | -4                               | 3.5   | 4.3   | 1.3  | 23                                | 0  |
| Lincoln Co.         | 3,605                  | 5,376                  | 1,771                          | 49                               | 1.0   | 3.2   | 3.4  | 220                               | 34   |
| Madison Co.         | 20,912                 | 39,370                 | 18,458                         | 88                               | 8.3   | 14.1  | 9.1  | 70                                | 100  |
| Minidoka Co.        | 20,228                 | 20,722                 | 494                            | 2                                | 9.7   | 12.9  | 5.0  | 33                                | 8  |
| Nez Perce Co.       | 32,858                 | 40,289                 | 7,431                          | 23                               | 20.5  | 26.8  | 9.8  | 31                                | 76   |

| <b>Idaho County</b>     | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Oneida Co.              | 3,279                  | 4,389                  | 1,110                          | 34                               | 6.1   | 7.5   | 2.2  | 23                                | 100  |
| Owyhee Co.              | 8,499                  | 11,618                 | 3,119                          | 37                               | 12.6  | 18.9  | 9.8  | 50                                | 77   |
| Payette Co.             | 15,999                 | 23,163                 | 7,164                          | 45                               | 9.2   | 12.6  | 5.3  | 37                                | 100  |
| Power Co.               | 6,935                  | 7,606                  | 671                            | 10                               | 10.9  | 13.2  | 3.6  | 21                                | 48   |
| Shoshone Co.            | 19,010                 | 12,519                 | -6,491                         | -34                              | 15.8  | 18.4  | 4.1  | 16                                | 0  |
| Teton Co.               | 3,185                  | 11,445                 | 8,260                          | 259                              | 2.8   | 10.6  | 12.2   | 279                               | 96   |
| Twin Falls Co.          | 53,958                 | 85,374                 | 31,416                         | 58                               | 23.8  | 44.8  | 32.8   | 88                                | 73   |
| Valley Co.              | 6,292                  | 10,667                 | 4,375                          | 70                               | 9.1   | 14.3  | 8.1  | 57                                | 100  |
| Washington Co.          | 8,962                  | 10,051                 | 1,089                          | 12                               | 7.2   | 8.6   | 2.2  | 19                                | 65   |
| <b>Totals</b>           | <b>973,719</b>         | <b>1,717,715</b>       | <b>743,996</b>                 | <b>76</b>                        | <b>560.5</b>                                  | <b>933.4</b>                                  | <b>582.7</b>   | <b>67</b>                         | <b>100</b>                                   |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>77</b>                                    |



**Scatter Plot for Idaho County Populations  
versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.92**

**Illinois**

| <b>Illinois County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adams Co.              | 71,174                 | 66,057                 | -5,117                         | -7                               | 23.4  | 32.7  | 14.5   | 40                                | 0  |
| Alexander Co.          | 12,056                 | 6,278                  | -5,778                         | -48                              | 3.7   | 4.0   | 0.5  | 8                                 | 0  |
| Bond Co.               | 16,132                 | 16,648                 | 516                            | 3                                | 10.3  | 13.0  | 4.2  | 26                                | 14   |
| Boone Co.              | 29,213                 | 53,513                 | 24,300                         | 83                               | 12.4  | 20.7  | 13.0   | 67                                | 100  |
| Brown Co.              | 5,588                  | 6,609                  | 1,021                          | 18                               | 5.3   | 7.3   | 3.1  | 38                                | 52   |
| Bureau Co.             | 38,790                 | 33,137                 | -5,653                         | -15                              | 22.2  | 23.6  | 2.2  | 6                                 | 0  |
| Calhoun Co.            | 5,739                  | 4,851                  | -888                           | -15                              | 3.8   | 4.5   | 1.1  | 18                                | 0  |
| Carroll Co.            | 18,548                 | 14,475                 | -4,073                         | -22                              | 9.3   | 13.8  | 7.0  | 48                                | 0  |
| Cass Co.               | 14,785                 | 12,492                 | -2,293                         | -16                              | 4.9   | 6.3   | 2.2  | 29                                | 0  |
| Champaign Co.          | 171,586                | 210,425                | 38,839                         | 23                               | 41.4  | 54.5  | 20.5   | 32                                | 74   |
| Christian Co.          | 36,279                 | 33,007                 | -3,272                         | -9                               | 16.9  | 19.4  | 3.9  | 15                                | 0  |

| <b>Illinois County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Clark Co.              | 17,071                 | 15,812                 | -1,259                         | -7                               | 11.2  | 12.2  | 1.6  | 9                                 | 0  |
| Clay Co.               | 15,706                 | 13,270                 | -2,436                         | -16                              | 10.3  | 12.6  | 3.6  | 22                                | 0  |
| Clinton Co.            | 33,597                 | 37,645                 | 4,048                          | 12                               | 13.6  | 19.7  | 9.5  | 45                                | 31   |
| Coles Co.              | 52,857                 | 51,353                 | -1,504                         | -3                               | 17.7  | 20.9  | 5.0  | 18                                | 0  |
| Cook Co.               | 5,222,484              | 5,200,821              | -21,663                        | 0                                | 490.5   | 539.0   | 75.8   | 10                                | 0  |
| Crawford Co.           | 21,292                 | 18,975                 | -2,317                         | -11                              | 9.9   | 14.2  | 6.7  | 43                                | 0  |
| Cumberland Co.         | 10,966                 | 10,880                 | -86                            | -1                               | 8.4   | 9.0   | 0.9  | 7                                 | 0  |
| DeKalb Co.             | 74,399                 | 104,309                | 29,910                         | 40                               | 21.6  | 31.3  | 15.2   | 45                                | 91   |
| De Witt Co.            | 17,861                 | 15,906                 | -1,955                         | -11                              | 9.7   | 11.8  | 3.3  | 22                                | 0  |
| Douglas Co.            | 19,793                 | 19,629                 | -164                           | -1                               | 13.2  | 15.0  | 2.8  | 14                                | 0  |
| DuPage Co.             | 682,289                | 930,265                | 247,976                        | 36                               | 142.5   | 186.3   | 68.4   | 31                                | 100  |
| Edgar Co.              | 21,729                 | 17,390                 | -4,339                         | -20                              | 11.6  | 12.1  | 0.8  | 4                                 | 0  |

| <b>Illinois County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Edwards Co.            | 8,129                  | 6,448                  | -1,681                         | -21                              | 2.9   | 2.9   | 0.0  | 0                                 | 0  |
| Effingham Co.          | 31,167                 | 34,123                 | 2,956                          | 9                                | 18.2  | 23.3  | 8.0  | 28                                | 37   |
| Fayette Co.            | 22,282                 | 21,514                 | -768                           | -3                               | 16.0  | 17.9  | 3.0  | 12                                | 0  |
| Ford Co.               | 15,311                 | 13,298                 | -2,013                         | -13                              | 8.1   | 9.5   | 2.2  | 17                                | 0  |
| Franklin Co.           | 43,561                 | 38,995                 | -4,566                         | -10                              | 11.9  | 19.3  | 11.6   | 62                                | 0  |
| Fulton Co.             | 43,107                 | 35,104                 | -8,003                         | -19                              | 18.4  | 23.3  | 7.7  | 27                                | 0  |
| Gallatin Co.           | 7,719                  | 5,071                  | -2,648                         | -34                              | 4.1   | 4.5   | 0.6  | 10                                | 0  |
| Greene Co.             | 16,519                 | 13,156                 | -3,363                         | -20                              | 8.2   | 9.2   | 1.6  | 12                                | 0  |
| Grundy Co.             | 30,677                 | 50,622                 | 19,945                         | 65                               | 19.5  | 33.8  | 22.3   | 73                                | 91   |
| Hamilton Co.           | 9,271                  | 8,181                  | -1,090                         | -12                              | 5.2   | 6.0   | 1.3  | 15                                | 0  |
| Hancock Co.            | 23,781                 | 17,958                 | -5,823                         | -24                              | 9.6   | 10.9  | 2.0  | 14                                | 0  |
| Hardin Co.             | 5,388                  | 3,922                  | -1,466                         | -27                              | 2.3   | 2.8   | 0.8  | 22                                | 0  |

| <b>Illinois County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Henderson Co.          | 8,976                  | 6,819                  | -2,157                         | -24                              | 6.9   | 8.0   | 1.7  | 16                                | 0  |
| Henry Co.              | 56,769                 | 49,219                 | -7,550                         | -13                              | 25.7  | 29.5  | 5.9  | 15                                | 0  |
| Iroquois Co.           | 33,081                 | 27,777                 | -5,304                         | -16                              | 24.5  | 29.0  | 7.0  | 18                                | 0  |
| Jackson Co.            | 62,399                 | 57,904                 | -4,495                         | -7                               | 21.4  | 29.0  | 11.9   | 36                                | 0  |
| Jasper Co.             | 11,491                 | 9,523                  | -1,968                         | -17                              | 6.7   | 6.9   | 0.3  | 3                                 | 0  |
| Jefferson Co.          | 38,004                 | 38,045                 | 41                             | 0                                | 21.4  | 30.5  | 14.2   | 43                                | 0  |
| Jersey Co.             | 20,611                 | 21,912                 | 1,301                          | 6                                | 9.7   | 13.0  | 5.2  | 34                                | 21   |
| Jo Daviess Co.         | 23,469                 | 21,495                 | -1,974                         | -8                               | 15.4  | 21.7  | 9.8  | 41                                | 0  |
| Johnson Co.            | 9,964                  | 12,399                 | 2,435                          | 24                               | 5.2   | 7.8   | 4.1  | 50                                | 54   |
| Kane Co.               | 278,859                | 532,272                | 253,413                        | 91                               | 72.8  | 129.2   | 88.1   | 77                                | 100  |
| Kankakee Co.           | 101,218                | 110,540                | 9,322                          | 9                                | 28.9  | 41.2  | 19.2   | 43                                | 25   |
| Kendall Co.            | 37,531                 | 126,152                | 88,621                         | 236                              | 14.5  | 32.8  | 28.6   | 126                               | 100  |

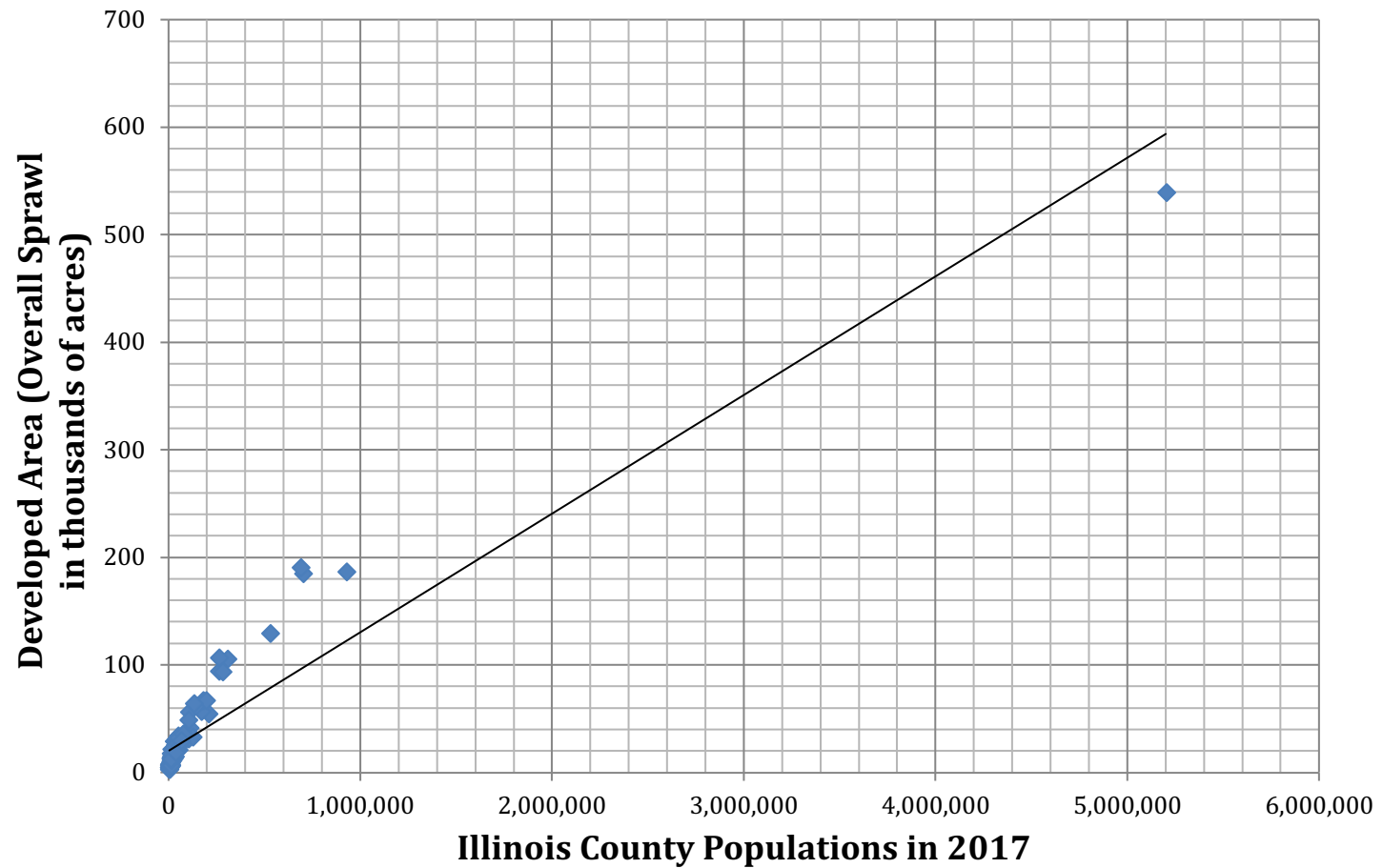
| <b>Illinois County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Knox Co.               | 59,943                 | 50,577                 | -9,366                         | -16                              | 28.1  | 30.7  | 4.1  | 9                                 | 0  |
| Lake Co.               | 451,470                | 702,475                | 251,005                        | 56                               | 117.4   | 184.6   | 105.0  | 57                                | 98   |
| La Salle Co.           | 109,687                | 109,622                | -65                            | 0                                | 34.8  | 56.1  | 33.3   | 61                                | 0  |
| Lawrence Co.           | 18,232                 | 16,027                 | -2,205                         | -12                              | 9.0   | 10.8  | 2.8  | 20                                | 0  |
| Lee Co.                | 35,724                 | 34,540                 | -1,184                         | -3                               | 19.3  | 24.1  | 7.5  | 25                                | 0  |
| Livingston Co.         | 41,003                 | 36,124                 | -4,879                         | -12                              | 22.3  | 25.4  | 4.8  | 14                                | 0  |
| Logan Co.              | 31,419                 | 29,034                 | -2,385                         | -8                               | 15.6  | 17.4  | 2.8  | 12                                | 0  |
| McDonough Co.          | 38,348                 | 30,373                 | -7,975                         | -21                              | 10.4  | 13.2  | 4.4  | 27                                | 0  |
| McHenry Co.            | 149,834                | 307,815                | 157,981                        | 105                              | 50.5  | 105.2   | 85.5   | 108                               | 98   |
| McLean Co.             | 120,379                | 172,754                | 52,375                         | 44                               | 37.6  | 56.9  | 30.2   | 51                                | 87   |
| Macon Co.              | 128,485                | 105,399                | -23,086                        | -18                              | 41.1  | 49.0  | 12.3   | 19                                | 0  |
| Macoupin Co.           | 49,412                 | 45,505                 | -3,907                         | -8                               | 17.4  | 21.9  | 7.0  | 26                                | 0  |

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|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Madison Co.            | 244,437                | 265,251                | 20,814                         | 9                                | 66.0  | 94.3  | 44.2   | 43                                | 23   |
| Marion Co.             | 44,347                 | 37,726                 | -6,621                         | -15                              | 17.4  | 24.3  | 10.8   | 40                                | 0  |
| Marshall Co.           | 14,308                 | 11,668                 | -2,640                         | -18                              | 7.9   | 9.8   | 3.0  | 24                                | 0  |
| Mason Co.              | 18,797                 | 13,677                 | -5,120                         | -27                              | 12.4  | 13.4  | 1.6  | 8                                 | 0  |
| Massac Co.             | 15,069                 | 14,291                 | -778                           | -5                               | 7.6   | 10.8  | 5.0  | 42                                | 0  |
| Menard Co.             | 11,682                 | 12,293                 | 611                            | 5                                | 4.6   | 5.4   | 1.3  | 17                                | 32   |
| Mercer Co.             | 19,468                 | 15,608                 | -3,860                         | -20                              | 9.2   | 10.4  | 1.9  | 13                                | 0  |
| Monroe Co.             | 20,341                 | 34,179                 | 13,838                         | 68                               | 10.0  | 14.7  | 7.3  | 47                                | 100  |
| Montgomery Co.         | 32,662                 | 28,781                 | -3,881                         | -12                              | 17.3  | 19.0  | 2.7  | 10                                | 0  |
| Morgan Co.             | 37,158                 | 34,245                 | -2,913                         | -8                               | 15.0  | 18.1  | 4.8  | 21                                | 0  |
| Moultrie Co.           | 14,650                 | 14,701                 | 51                             | 0                                | 5.5   | 6.7   | 1.9  | 22                                | 2  |
| Ogle Co.               | 46,059                 | 50,993                 | 4,934                          | 11                               | 26.5  | 32.5  | 9.4  | 23                                | 50   |

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|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Peoria Co.             | 197,990                | 182,525                | -15,465                        | -8                               | 49.8  | 67.0  | 26.9   | 35                                | 0  |
| Perry Co.              | 21,977                 | 21,281                 | -696                           | -3                               | 10.2  | 11.2  | 1.6  | 10                                | 0  |
| Piatt Co.              | 16,493                 | 16,422                 | -71                            | 0                                | 8.3   | 11.0  | 4.2  | 33                                | 0  |
| Pike Co.               | 18,879                 | 15,668                 | -3,211                         | -17                              | 11.4  | 15.5  | 6.4  | 36                                | 0  |
| Pope Co.               | 4,367                  | 4,183                  | -184                           | -4                               | 3.2   | 4.3   | 1.7  | 34                                | 0  |
| Pulaski Co.            | 8,733                  | 5,520                  | -3,213                         | -37                              | 5.3   | 6.2   | 1.4  | 17                                | 0  |
| Putnam Co.             | 6,076                  | 5,694                  | -382                           | -6                               | 6.2   | 8.0   | 2.8  | 29                                | 0  |
| Randolph Co.           | 35,825                 | 32,297                 | -3,528                         | -10                              | 18.9  | 20.6  | 2.7  | 9                                 | 0  |
| Richland Co.           | 18,515                 | 15,837                 | -2,678                         | -14                              | 11.3  | 12.5  | 1.9  | 11                                | 0  |
| Rock Island Co.        | 166,165                | 143,828                | -22,337                        | -13                              | 56.4  | 61.9  | 8.6  | 10                                | 0  |
| St. Clair Co.          | 266,073                | 262,600                | -3,473                         | -1                               | 78.5  | 106.7   | 44.1   | 36                                | 0  |
| Saline Co.             | 28,953                 | 23,963                 | -4,990                         | -17                              | 10.9  | 13.6  | 4.2  | 25                                | 0  |

| <b>Illinois County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Sangamon Co.           | 175,162                | 197,072                | 21,910                         | 13                               | 50.7  | 67.0  | 25.5   | 32                                | 42   |
| Schuyler Co.           | 8,237                  | 6,948                  | -1,289                         | -16                              | 4.9   | 6.1   | 1.9  | 24                                | 0  |
| Scott Co.              | 6,059                  | 4,983                  | -1,076                         | -18                              | 5.8   | 7.0   | 1.9  | 21                                | 0  |
| Shelby Co.             | 23,630                 | 21,774                 | -1,856                         | -8                               | 13.3  | 18.2  | 7.7  | 37                                | 0  |
| Stark Co.              | 7,252                  | 5,457                  | -1,795                         | -25                              | 6.1   | 6.7   | 0.9  | 10                                | 0  |
| Stephenson Co.         | 49,842                 | 44,997                 | -4,845                         | -10                              | 18.7  | 23.9  | 8.1  | 28                                | 0  |
| Tazewell Co.           | 130,451                | 133,489                | 3,038                          | 2                                | 51.6  | 63.9  | 19.2   | 24                                | 11   |
| Union Co.              | 18,043                 | 16,968                 | -1,075                         | -6                               | 9.5   | 11.7  | 3.4  | 23                                | 0  |
| Vermilion Co.          | 92,998                 | 77,689                 | -15,309                        | -16                              | 30.4  | 35.9  | 8.6  | 18                                | 0  |
| Wabash Co.             | 13,913                 | 11,523                 | -2,390                         | -17                              | 6.1   | 6.5   | 0.6  | 7                                 | 0  |
| Warren Co.             | 21,638                 | 17,144                 | -4,494                         | -21                              | 10.0  | 11.5  | 2.3  | 15                                | 0  |
| Washington Co.         | 15,517                 | 13,963                 | -1,554                         | -10                              | 11.2  | 17.5  | 9.8  | 56                                | 0  |

| <b>Illinois County</b>  | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Wayne Co.               | 18,613                 | 16,412                 | -2,201                         | -12                              | 17.2  | 21.5  | 6.7  | 25                                | 0  |
| White Co.               | 18,403                 | 13,903                 | -4,500                         | -24                              | 7.6   | 12.6  | 7.8  | 66                                | 0  |
| Whiteside Co.           | 64,356                 | 55,955                 | -8,401                         | -13                              | 18.9  | 24.8  | 9.2  | 31                                | 0  |
| Will Co.                | 325,943                | 690,479                | 364,536                        | 112                              | 104.3   | 190.2   | 134.2  | 82                                | 100  |
| Williamson Co.          | 57,917                 | 67,049                 | 9,132                          | 16                               | 20.8  | 29.5  | 13.6   | 42                                | 42   |
| Winnebago Co.           | 249,698                | 284,681                | 34,983                         | 14                               | 66.4  | 93.4  | 42.2   | 41                                | 38   |
| Woodford Co.            | 33,563                 | 38,670                 | 5,107                          | 15                               | 15.2  | 18.9  | 5.8  | 24                                | 65   |
| <b>Totals</b>           | <b>11,423,413</b>      | <b>12,778,828</b>      | <b>1,355,415</b>               | <b>12</b>                        | <b>2,633.3</b>                                | <b>3,485.9</b>                                | <b>1,332.2</b>   | <b>32</b>                         | <b>40</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>50</b>                                    |



**Scatter Plot for Illinois County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.94**

**Indiana**

| <b>Indiana County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adams Co.             | 29,759                 | 35,385                 | 5,626                          | 19                               | 10.0  | 15.9  | 9.2  | 59                                | 37   |
| Allen Co.             | 288,893                | 371,723                | 82,830                         | 29                               | 72.9  | 108.6   | 55.8   | 49                                | 63   |
| Bartholomew Co.       | 63,992                 | 82,213                 | 18,221                         | 28                               | 23.2  | 32.3  | 14.2   | 39                                | 76   |
| Benton Co.            | 10,065                 | 8,631                  | -1,434                         | -14                              | 8.3   | 8.7   | 0.6  | 5                                 | 0  |
| Blackford Co.         | 15,297                 | 12,028                 | -3,269                         | -21                              | 4.8   | 6.2   | 2.2  | 29                                | 0  |
| Boone Co.             | 37,179                 | 65,723                 | 28,544                         | 77                               | 17.0  | 22.9  | 9.2  | 35                                | 100  |
| Brown Co.             | 12,467                 | 15,010                 | 2,543                          | 20                               | 6.3   | 9.9   | 5.6  | 57                                | 41   |
| Carroll Co.           | 19,506                 | 20,067                 | 561                            | 3                                | 11.1  | 15.7  | 7.2  | 41                                | 8  |
| Cass Co.              | 40,480                 | 37,828                 | -2,652                         | -7                               | 17.4  | 21.2  | 5.9  | 22                                | 0  |
| Clark Co.             | 89,400                 | 116,545                | 27,145                         | 30                               | 25.3  | 41.9  | 25.9   | 66                                | 53   |
| Clay Co.              | 24,637                 | 26,167                 | 1,530                          | 6                                | 10.9  | 13.3  | 3.8  | 22                                | 30   |

| <b>Indiana County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Clinton Co.           | 31,532                 | 32,195                 | 663                            | 2                                | 13.0  | 17.0  | 6.3  | 31                                | 8  |
| Crawford Co.          | 9,660                  | 10,535                 | 875                            | 9                                | 5.7   | 9.9   | 6.6  | 74                                | 16   |
| Daviess Co.           | 28,348                 | 33,136                 | 4,788                          | 17                               | 9.7   | 16.6  | 10.8   | 71                                | 29   |
| Dearborn Co.          | 35,000                 | 49,564                 | 14,564                         | 42                               | 13.0  | 21.5  | 13.3   | 65                                | 69   |
| Decatur Co.           | 23,632                 | 26,620                 | 2,988                          | 13                               | 9.7   | 14.7  | 7.8  | 52                                | 29   |
| De Kalb Co.           | 33,000                 | 42,806                 | 9,806                          | 30                               | 12.7  | 20.0  | 11.4   | 57                                | 57   |
| Delaware Co.          | 125,887                | 115,246                | -10,641                        | -8                               | 25.1  | 40.0  | 23.3   | 59                                | 0  |
| Dubois Co.            | 34,496                 | 42,538                 | 8,042                          | 23                               | 16.8  | 22.4  | 8.8  | 33                                | 73   |
| Elkhart Co.           | 138,179                | 204,194                | 66,015                         | 48                               | 49.5  | 81.2  | 49.5   | 64                                | 79   |
| Fayette Co.           | 27,826                 | 23,154                 | -4,672                         | -17                              | 7.1   | 8.5   | 2.2  | 20                                | 0  |
| Floyd Co.             | 62,301                 | 77,006                 | 14,705                         | 24                               | 24.3  | 35.1  | 16.9   | 44                                | 58   |
| Fountain Co.          | 19,185                 | 16,419                 | -2,766                         | -14                              | 9.5   | 12.1  | 4.1  | 27                                | 0  |

| <b>Indiana County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Franklin Co.          | 19,788                 | 22,694                 | 2,906                          | 15                               | 9.1   | 12.0  | 4.5  | 32                                | 50   |
| Fulton Co.            | 19,114                 | 19,995                 | 881                            | 5                                | 12.2  | 15.7  | 5.5  | 29                                | 18   |
| Gibson Co.            | 33,806                 | 33,721                 | -85                            | 0                                | 14.2  | 22.1  | 12.3   | 56                                | 0  |
| Grant Co.             | 78,249                 | 66,305                 | -11,944                        | -15                              | 31.1  | 35.3  | 6.6  | 14                                | 0  |
| Greene Co.            | 30,289                 | 32,172                 | 1,883                          | 6                                | 14.8  | 23.6  | 13.8   | 59                                | 13   |
| Hamilton Co.          | 84,584                 | 322,933                | 238,349                        | 282                              | 36.8  | 90.6  | 84.1   | 146                               | 100  |
| Hancock Co.           | 44,049                 | 74,998                 | 30,949                         | 70                               | 18.1  | 26.4  | 13.0   | 46                                | 100  |
| Harrison Co.          | 28,041                 | 39,777                 | 11,736                         | 42                               | 18.1  | 28.0  | 15.5   | 55                                | 80   |
| Hendricks Co.         | 71,090                 | 163,622                | 92,532                         | 130                              | 31.6  | 60.6  | 45.3   | 92                                | 100  |
| Henry Co.             | 51,424                 | 48,170                 | -3,254                         | -6                               | 17.9  | 23.1  | 8.1  | 29                                | 0  |
| Howard Co.            | 85,004                 | 82,210                 | -2,794                         | -3                               | 20.2  | 25.4  | 8.1  | 26                                | 0  |
| Huntington Co.        | 34,638                 | 36,222                 | 1,584                          | 5                                | 13.3  | 24.1  | 16.9   | 81                                | 8  |

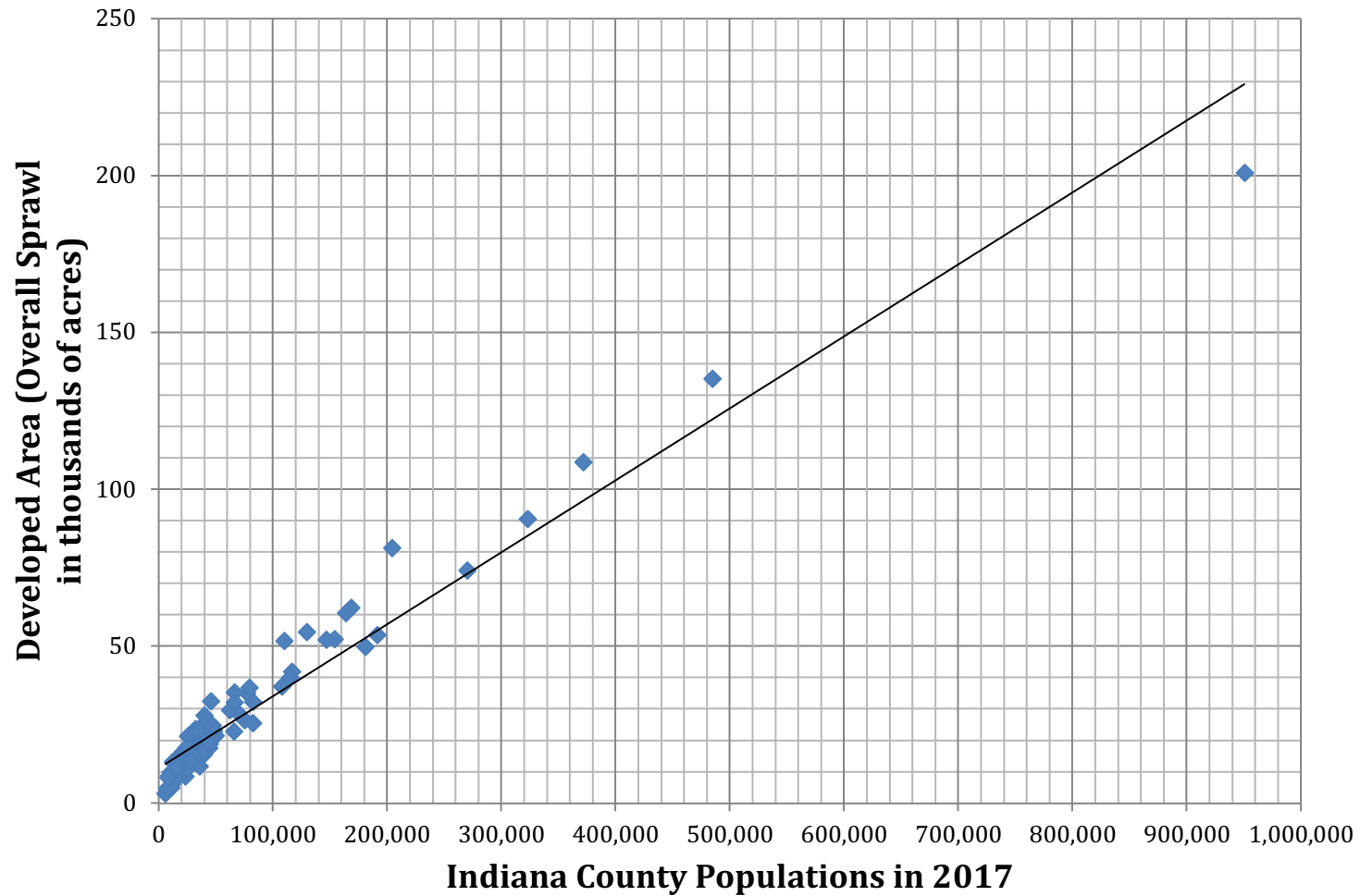
| <b>Indiana County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Jackson Co.           | 37,145                 | 43,955                 | 6,810                          | 18                               | 14.0  | 17.5  | 5.5  | 25                                | 75   |
| Jasper Co.            | 26,571                 | 33,424                 | 6,853                          | 26                               | 13.6  | 20.3  | 10.5   | 49                                | 57   |
| Jay Co.               | 22,705                 | 20,883                 | -1,822                         | -8                               | 8.3   | 11.7  | 5.3  | 41                                | 0  |
| Jefferson Co.         | 30,558                 | 32,013                 | 1,455                          | 5                                | 12.1  | 15.9  | 5.9  | 31                                | 17   |
| Jennings Co.          | 23,022                 | 27,652                 | 4,630                          | 20                               | 13.3  | 17.5  | 6.6  | 32                                | 67   |
| Johnson Co.           | 79,572                 | 153,820                | 74,248                         | 93                               | 36.2  | 52.2  | 25.0   | 44                                | 100  |
| Knox Co.              | 42,285                 | 37,044                 | -5,241                         | -12                              | 19.4  | 23.4  | 6.3  | 21                                | 0  |
| Kosciusko Co.         | 59,725                 | 79,026                 | 19,301                         | 32                               | 23.0  | 36.7  | 21.4   | 60                                | 60   |
| Lagrange Co.          | 26,504                 | 39,248                 | 12,744                         | 48                               | 10.8  | 15.4  | 7.2  | 43                                | 100  |
| Lake Co.              | 508,830                | 484,601                | -24,229                        | -5                               | 107.6   | 135.1   | 43.0   | 26                                | 0  |
| La Porte Co.          | 108,140                | 109,842                | 1,702                          | 2                                | 41.1  | 51.6  | 16.4   | 26                                | 7  |
| Lawrence Co.          | 41,832                 | 45,592                 | 3,760                          | 9                                | 20.1  | 32.4  | 19.2   | 61                                | 18   |

| <b>Indiana County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Madison Co.           | 134,754                | 129,418                | -5,336                         | -4                               | 41.7  | 54.5  | 20.0   | 31                                | 0  |
| Marion Co.            | 765,821                | 950,537                | 184,716                        | 24                               | 146.6   | 200.8   | 84.7   | 37                                | 69   |
| Marshall Co.          | 39,942                 | 46,433                 | 6,491                          | 16                               | 16.7  | 21.0  | 6.7  | 26                                | 66   |
| Martin Co.            | 10,868                 | 10,181                 | -687                           | -6                               | 7.2   | 8.9   | 2.7  | 24                                | 0  |
| Miami Co.             | 38,470                 | 35,864                 | -2,606                         | -7                               | 8.6   | 11.7  | 4.8  | 36                                | 0  |
| Monroe Co.            | 101,721                | 146,638                | 44,917                         | 44                               | 33.1  | 52.0  | 29.5   | 57                                | 81   |
| Montgomery Co.        | 35,160                 | 38,343                 | 3,183                          | 9                                | 13.0  | 16.3  | 5.2  | 25                                | 38   |
| Morgan Co.            | 52,650                 | 69,793                 | 17,143                         | 33                               | 14.1  | 28.5  | 22.5   | 102                               | 40   |
| Newton Co.            | 14,454                 | 14,027                 | -427                           | -3                               | 7.4   | 8.9   | 2.3  | 20                                | 0  |
| Noble Co.             | 35,344                 | 47,329                 | 11,985                         | 34                               | 6.8   | 24.7  | 28.0   | 263                               | 23   |
| Ohio Co.              | 5,208                  | 5,854                  | 646                            | 12                               | 2.1   | 3.1   | 1.6  | 48                                | 30   |
| Orange Co.            | 18,747                 | 19,423                 | 676                            | 4                                | 8.3   | 11.9  | 5.6  | 43                                | 10   |

| <b>Indiana County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Owen Co.              | 15,799                 | 20,791                 | 4,992                          | 32                               | 7.5   | 10.3  | 4.4  | 37                                | 87   |
| Parke Co.             | 16,528                 | 16,907                 | 379                            | 2                                | 11.0  | 12.7  | 2.7  | 15                                | 16   |
| Perry Co.             | 19,258                 | 18,978                 | -280                           | -1                               | 12.2  | 14.6  | 3.8  | 20                                | 0  |
| Pike Co.              | 13,348                 | 12,315                 | -1,033                         | -8                               | 10.4  | 13.1  | 4.2  | 26                                | 0  |
| Porter Co.            | 122,754                | 168,495                | 45,741                         | 37                               | 40.3  | 62.2  | 34.2   | 54                                | 73   |
| Posey Co.             | 26,599                 | 25,569                 | -1,030                         | -4                               | 15.6  | 21.3  | 8.9  | 37                                | 0  |
| Pulaski Co.           | 13,161                 | 12,529                 | -632                           | -5                               | 10.5  | 13.3  | 4.4  | 27                                | 0  |
| Putnam Co.            | 29,268                 | 37,363                 | 8,095                          | 28                               | 16.5  | 21.2  | 7.3  | 28                                | 97   |
| Randolph Co.          | 29,143                 | 24,907                 | -4,236                         | -15                              | 8.7   | 11.0  | 3.6  | 26                                | 0  |
| Ripley Co.            | 24,319                 | 28,428                 | 4,109                          | 17                               | 7.7   | 14.5  | 10.6   | 88                                | 25   |
| Rush Co.              | 19,229                 | 16,643                 | -2,586                         | -13                              | 8.9   | 10.3  | 2.2  | 16                                | 0  |
| St. Joseph Co.        | 238,741                | 270,057                | 31,316                         | 13                               | 52.0  | 74.1  | 34.5   | 43                                | 35   |

| <b>Indiana County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Scott Co.             | 20,528                 | 23,793                 | 3,265                          | 16                               | 10.7  | 13.5  | 4.4  | 26                                | 63   |
| Shelby Co.            | 39,962                 | 44,367                 | 4,405                          | 11                               | 14.5  | 18.8  | 6.7  | 30                                | 40   |
| Spencer Co.           | 19,811                 | 20,440                 | 629                            | 3                                | 10.9  | 13.6  | 4.2  | 25                                | 14   |
| Starke Co.            | 21,504                 | 22,935                 | 1,431                          | 7                                | 14.0  | 16.8  | 4.4  | 20                                | 35   |
| Steuben Co.           | 24,589                 | 34,384                 | 9,795                          | 40                               | 14.9  | 22.4  | 11.7   | 50                                | 82   |
| Sullivan Co.          | 20,595                 | 20,700                 | 105                            | 1                                | 13.4  | 16.2  | 4.4  | 21                                | 3  |
| Switzerland Co.       | 7,371                  | 10,686                 | 3,315                          | 45                               | 3.5   | 5.0   | 2.3  | 43                                | 100  |
| Tippecanoe Co.        | 124,167                | 191,199                | 67,032                         | 54                               | 36.8  | 53.6  | 26.3   | 46                                | 100  |
| Tipton Co.            | 16,461                 | 15,137                 | -1,324                         | -8                               | 6.5   | 8.1   | 2.5  | 25                                | 0  |
| Union Co.             | 6,887                  | 7,159                  | 272                            | 4                                | 3.7   | 4.7   | 1.6  | 27                                | 16   |
| Vanderburgh Co.       | 166,793                | 180,954                | 14,161                         | 8                                | 38.9  | 49.8  | 17.0   | 28                                | 33   |
| Vermillion Co.        | 18,240                 | 15,503                 | -2,737                         | -15                              | 10.7  | 11.4  | 1.1  | 7                                 | 0  |

| <b>Indiana County</b>   | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Vigo Co.                | 111,309                | 107,569                | -3,740                         | -3                               | 32.2  | 37.1  | 7.7  | 15                                | 0  |
| Wabash Co.              | 35,992                 | 31,380                 | -4,612                         | -13                              | 10.7  | 15.0  | 6.7  | 40                                | 0  |
| Warren Co.              | 8,908                  | 8,204                  | -704                           | -8                               | 6.7   | 8.1   | 2.2  | 21                                | 0  |
| Warrick Co.             | 42,818                 | 62,401                 | 19,583                         | 46                               | 21.1  | 29.6  | 13.3   | 40                                | 100  |
| Washington Co.          | 22,177                 | 27,771                 | 5,594                          | 25                               | 9.7   | 15.6  | 9.2  | 61                                | 47   |
| Wayne Co.               | 75,095                 | 66,179                 | -8,916                         | -12                              | 27.3  | 32.1  | 7.5  | 18                                | 0  |
| Wells Co.               | 25,385                 | 27,958                 | 2,573                          | 10                               | 11.4  | 13.6  | 3.4  | 19                                | 55   |
| White Co.               | 23,990                 | 24,163                 | 173                            | 1                                | 13.6  | 17.8  | 6.6  | 31                                | 3  |
| Whitley Co.             | 26,364                 | 33,722                 | 7,358                          | 28                               | 10.7  | 23.3  | 19.7   | 118                               | 32   |
| <b>Totals</b>           | <b>5,467,918</b>       | <b>6,658,078</b>       | <b>1,190,160</b>               | <b>22</b>                        | <b>1,789.0</b>                                | <b>2,559.2</b>                                | <b>1,203.4</b>   | <b>43</b>                         | <b>55</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>51</b>                                    |



**Scatter Plot for Indiana County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.97**

**Iowa**

| <b>Iowa County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adair Co.          | 9,258                  | 7,051                  | -2,207                         | -24                              | 10.9  | 11.2  | 0.5  | 3                                 | 0  |
| Adams Co.          | 5,556                  | 3,657                  | -1,899                         | -34                              | 9.7   | 9.9   | 0.3  | 2                                 | 0  |
| Allamakee Co.      | 14,870                 | 13,803                 | -1,067                         | -7                               | 13.9  | 16.3  | 3.8  | 17                                | 0  |
| Appanoose Co.      | 15,157                 | 12,353                 | -2,804                         | -18                              | 16.0  | 17.0  | 1.6  | 6                                 | 0  |
| Audubon Co.        | 8,356                  | 5,550                  | -2,806                         | -34                              | 10.1  | 11.1  | 1.6  | 10                                | 0  |
| Benton Co.         | 23,301                 | 25,656                 | 2,355                          | 10                               | 19.6  | 22.7  | 4.8  | 16                                | 66   |
| Black Hawk Co.     | 136,836                | 132,238                | -4,598                         | -3                               | 47.9  | 54.8  | 10.8   | 14                                | 0  |
| Boone Co.          | 26,058                 | 26,443                 | 385                            | 1                                | 15.8  | 19.6  | 5.9  | 24                                | 7  |
| Bremer Co.         | 24,661                 | 24,823                 | 162                            | 1                                | 13.7  | 17.3  | 5.6  | 26                                | 3  |
| Buchanan Co.       | 22,976                 | 21,126                 | -1,850                         | -8                               | 14.8  | 17.5  | 4.2  | 18                                | 0  |
| Buena Vista Co.    | 20,854                 | 20,144                 | -710                           | -3                               | 10.0  | 10.8  | 1.3  | 8                                 | 0  |

| <b>Iowa County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Butler Co.         | 17,431                 | 14,592                 | -2,839                         | -16                              | 11.9  | 13.1  | 1.9  | 10                                | 0  |
| Calhoun Co.        | 13,243                 | 9,729                  | -3,514                         | -27                              | 9.7   | 9.7   | 0.0  | 0                                 | 0  |
| Carroll Co.        | 22,665                 | 20,274                 | -2,391                         | -11                              | 19.7  | 22.4  | 4.2  | 14                                | 0  |
| Cass Co.           | 16,918                 | 13,144                 | -3,774                         | -22                              | 14.7  | 15.2  | 0.8  | 3                                 | 0  |
| Cedar Co.          | 18,516                 | 18,490                 | -26                            | 0                                | 13.5  | 16.2  | 4.2  | 20                                | 0  |
| Cerro Gordo Co.    | 48,220                 | 42,999                 | -5,221                         | -11                              | 23.4  | 26.4  | 4.7  | 13                                | 0  |
| Cherokee Co.       | 15,869                 | 11,307                 | -4,562                         | -29                              | 14.4  | 14.4  | 0.0  | 0                                 | 0  |
| Chickasaw Co.      | 15,211                 | 12,002                 | -3,209                         | -21                              | 12.7  | 13.2  | 0.8  | 4                                 | 0  |
| Clarke Co.         | 8,723                  | 9,396                  | 673                            | 8                                | 10.4  | 11.9  | 2.3  | 14                                | 55   |
| Clay Co.           | 19,220                 | 16,141                 | -3,079                         | -16                              | 13.8  | 17.3  | 5.5  | 25                                | 0  |
| Clayton Co.        | 20,801                 | 17,648                 | -3,153                         | -15                              | 15.8  | 17.1  | 2.0  | 8                                 | 0  |
| Clinton Co.        | 56,359                 | 46,874                 | -9,485                         | -17                              | 24.2  | 27.3  | 4.8  | 13                                | 0  |

| <b>Iowa County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Crawford Co.       | 18,842                 | 17,076                 | -1,766                         | -9                               | 16.4  | 19.2  | 4.4  | 17                                | 0  |
| Dallas Co.         | 29,174                 | 87,208                 | 58,034                         | 199                              | 16.9  | 26.4  | 14.8   | 56                                | 100  |
| Davis Co.          | 9,025                  | 8,969                  | -56                            | -1                               | 8.0   | 8.4   | 0.6  | 5                                 | 0  |
| Decatur Co.        | 9,583                  | 7,947                  | -1,636                         | -17                              | 9.9   | 10.5  | 0.9  | 6                                 | 0  |
| Delaware Co.       | 18,718                 | 17,143                 | -1,575                         | -8                               | 14.3  | 17.2  | 4.5  | 20                                | 0  |
| Des Moines Co.     | 45,420                 | 39,326                 | -6,094                         | -13                              | 19.0  | 23.8  | 7.5  | 25                                | 0  |
| Dickinson Co.      | 15,384                 | 17,141                 | 1,757                          | 11                               | 12.4  | 13.4  | 1.6  | 8                                 | 100  |
| Dubuque Co.        | 91,992                 | 97,066                 | 5,074                          | 6                                | 37.8  | 49.4  | 18.1   | 31                                | 20   |
| Emmet Co.          | 13,143                 | 9,422                  | -3,721                         | -28                              | 6.8   | 6.7   | -0.2   | -1                                | 0  |
| Fayette Co.        | 24,837                 | 19,687                 | -5,150                         | -21                              | 14.4  | 14.9  | 0.8  | 3                                 | 0  |
| Floyd Co.          | 19,103                 | 15,767                 | -3,336                         | -17                              | 8.4   | 8.1   | -0.5   | -4                                | 100  |
| Franklin Co.       | 12,787                 | 10,160                 | -2,627                         | -21                              | 12.4  | 12.4  | 0.0  | 0                                 | 0  |

| Iowa County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Fremont Co.  | 9,166           | 6,930           | -2,236                  | -24                       | 13.0                                   | 13.3                                   | 0.5   | 2                          | 0                                     |
| Greene Co.   | 11,790          | 8,954           | -2,836                  | -24                       | 8.9                                    | 8.9                                    | 0.0   | 0                          | 0                                     |
| Grundy Co.   | 13,947          | 12,298          | -1,649                  | -12                       | 7.0                                    | 7.0                                    | 0.0   | 0                          | 0                                     |
| Guthrie Co.  | 11,687          | 10,645          | -1,042                  | -9                        | 14.6                                   | 16.2                                   | 2.5   | 11                         | 0                                     |
| Hamilton Co. | 17,590          | 15,032          | -2,558                  | -15                       | 16.9                                   | 18.1                                   | 1.9   | 7                          | 0                                     |
| Hancock Co.  | 13,583          | 10,756          | -2,827                  | -21                       | 15.4                                   | 16.5                                   | 1.7   | 7                          | 0                                     |
| Hardin Co.   | 21,547          | 17,073          | -4,474                  | -21                       | 20.9                                   | 22.6                                   | 2.7   | 8                          | 0                                     |
| Harrison Co. | 16,034          | 14,107          | -1,927                  | -12                       | 17.5                                   | 19.3                                   | 2.8   | 10                         | 0                                     |
| Henry Co.    | 18,689          | 20,044          | 1,355                   | 7                         | 13.5                                   | 17.5                                   | 6.3   | 30                         | 27                                    |
| Howard Co.   | 10,907          | 9,229           | -1,678                  | -15                       | 8.6                                    | 9.1                                    | 0.8   | 6                          | 0                                     |
| Humboldt Co. | 11,971          | 9,569           | -2,402                  | -20                       | 10.8                                   | 10.7                                   | -0.2  | -1                         | 0                                     |
| Ida Co.      | 8,744           | 6,869           | -1,875                  | -21                       | 7.8                                    | 9.9                                    | 3.3   | 27                         | 0                                     |

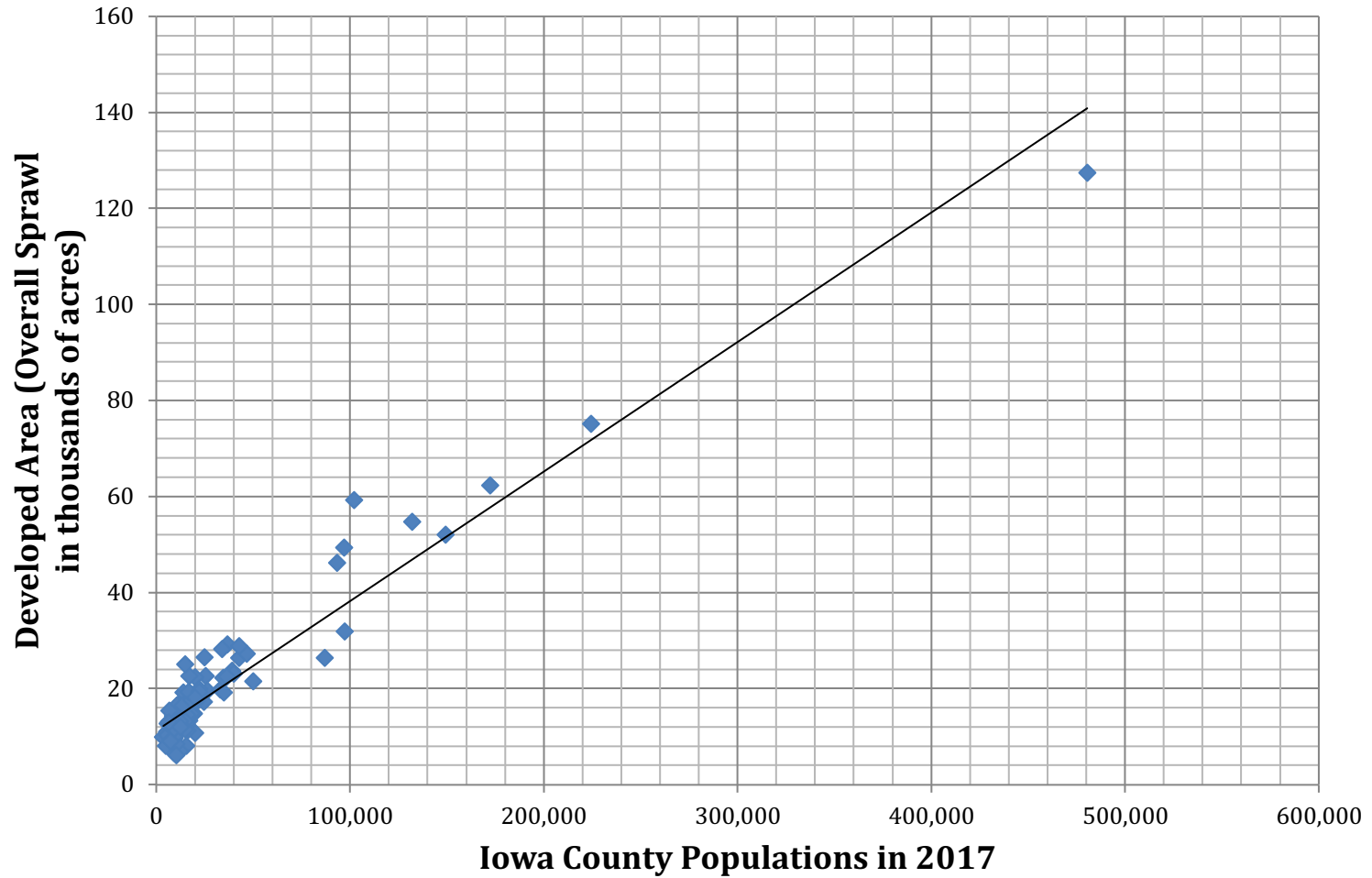
| Iowa County   | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Iowa Co.      | 15,155          | 16,133          | 978                     | 6                         | 11.0                                   | 11.3                                   | 0.5   | 3                          | 100                                   |
| Jackson Co.   | 22,075          | 19,382          | -2,693                  | -12                       | 13.7                                   | 14.8                                   | 1.7   | 8                          | 0                                     |
| Jasper Co.    | 35,708          | 36,995          | 1,287                   | 4                         | 23.2                                   | 29.2                                   | 9.4   | 26                         | 15                                    |
| Jefferson Co. | 16,315          | 18,219          | 1,904                   | 12                        | 11.9                                   | 14.9                                   | 4.7   | 25                         | 49                                    |
| Johnson Co.   | 84,633          | 149,325         | 64,692                  | 76                        | 32.3                                   | 52.1                                   | 30.9  | 61                         | 100                                   |
| Jones Co.     | 20,019          | 20,618          | 599                     | 3                         | 13.1                                   | 17.7                                   | 7.2   | 35                         | 10                                    |
| Keokuk Co.    | 12,639          | 10,141          | -2,498                  | -20                       | 13.3                                   | 14.6                                   | 2.0   | 10                         | 0                                     |
| Kossuth Co.   | 21,203          | 14,939          | -6,264                  | -30                       | 24.2                                   | 25.1                                   | 1.4   | 4                          | 0                                     |
| Lee Co.       | 42,265          | 34,216          | -8,049                  | -19                       | 23.3                                   | 28.3                                   | 7.8   | 21                         | 0                                     |
| Linn Co.      | 167,054         | 224,379         | 57,325                  | 34                        | 57.3                                   | 75.2                                   | 28.0  | 31                         | 100                                   |
| Louisa Co.    | 12,006          | 11,195          | -811                    | -7                        | 14.0                                   | 15.0                                   | 1.6   | 7                          | 0                                     |
| Lucas Co.     | 10,276          | 8,533           | -1,743                  | -17                       | 9.8                                    | 11.4                                   | 2.5   | 16                         | 0                                     |

| <b>Iowa County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Lyon Co.           | 12,703                 | 11,785                 | -918                           | -7                               | 10.0  | 11.0  | 1.6  | 10                                | 0  |
| Madison Co.        | 12,470                 | 16,000                 | 3,530                          | 28                               | 12.4  | 14.6  | 3.4  | 18                                | 100  |
| Mahaska Co.        | 22,279                 | 22,211                 | -68                            | 0                                | 14.7  | 20.0  | 8.3  | 36                                | 0  |
| Marion Co.         | 29,923                 | 33,091                 | 3,168                          | 11                               | 15.8  | 19.9  | 6.4  | 26                                | 44   |
| Marshall Co.       | 41,824                 | 40,078                 | -1,746                         | -4                               | 21.0  | 23.1  | 3.3  | 10                                | 0  |
| Mills Co.          | 13,379                 | 15,060                 | 1,681                          | 13                               | 12.0  | 13.2  | 1.9  | 10                                | 100  |
| Mitchell Co.       | 11,943                 | 10,563                 | -1,380                         | -12                              | 7.9   | 8.5   | 0.9  | 8                                 | 0  |
| Monona Co.         | 11,402                 | 8,724                  | -2,678                         | -23                              | 12.9  | 14.4  | 2.3  | 12                                | 0  |
| Monroe Co.         | 8,949                  | 7,798                  | -1,151                         | -13                              | 6.8   | 9.4   | 4.1  | 38                                | 0  |
| Montgomery Co.     | 13,146                 | 10,112                 | -3,034                         | -23                              | 9.5   | 10.3  | 1.3  | 8                                 | 0  |
| Muscatine Co.      | 41,404                 | 42,872                 | 1,468                          | 4                                | 22.5  | 28.9  | 10.0   | 28                                | 14   |
| O'Brien Co.        | 16,859                 | 13,774                 | -3,085                         | -18                              | 15.7  | 16.6  | 1.4  | 6                                 | 0  |

| <b>Iowa County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Osceola Co.        | 8,123                  | 6,021                  | -2,102                         | -26                              | 9.1   | 10.3  | 1.9  | 13                                | 0  |
| Page Co.           | 18,606                 | 15,213                 | -3,393                         | -18                              | 10.5  | 11.6  | 1.7  | 10                                | 0  |
| Palo Alto Co.      | 12,505                 | 9,052                  | -3,453                         | -28                              | 11.0  | 11.6  | 0.9  | 5                                 | 0  |
| Plymouth Co.       | 24,431                 | 25,060                 | 629                            | 3                                | 23.3  | 26.6  | 5.2  | 14                                | 19   |
| Pocahontas Co.     | 10,969                 | 6,833                  | -4,136                         | -38                              | 14.2  | 15.4  | 1.9  | 8                                 | 0  |
| Polk Co.           | 304,567                | 480,487                | 175,920                        | 58                               | 79.8  | 127.4   | 74.4   | 60                                | 97   |
| Pottawattamie Co.  | 85,934                 | 93,416                 | 7,482                          | 9                                | 39.7  | 46.2  | 10.2   | 16                                | 55   |
| Poweshiek Co.      | 19,096                 | 18,334                 | -762                           | -4                               | 16.3  | 17.6  | 2.0  | 8                                 | 0  |
| Ringgold Co.       | 6,104                  | 5,024                  | -1,080                         | -18                              | 7.8   | 8.1   | 0.5  | 4                                 | 0  |
| Sac Co.            | 13,740                 | 9,803                  | -3,937                         | -29                              | 12.0  | 13.1  | 1.7  | 9                                 | 0  |
| Scott Co.          | 159,622                | 172,448                | 12,826                         | 8                                | 51.2  | 62.4  | 17.5   | 22                                | 39   |
| Shelby Co.         | 14,780                 | 11,574                 | -3,206                         | -22                              | 10.8  | 13.3  | 3.9  | 23                                | 0  |

| <b>Iowa County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Sioux Co.          | 30,534                 | 34,781                 | 4,247                          | 14                               | 20.7  | 22.3  | 2.5  | 8                                 | 100  |
| Story Co.          | 72,292                 | 97,278                 | 24,986                         | 35                               | 20.5  | 31.9  | 17.8   | 56                                | 67   |
| Tama Co.           | 19,204                 | 17,029                 | -2,175                         | -11                              | 16.8  | 19.4  | 4.1  | 15                                | 0  |
| Taylor Co.         | 8,311                  | 6,095                  | -2,216                         | -27                              | 10.2  | 12.8  | 4.1  | 25                                | 0  |
| Union Co.          | 13,749                 | 12,459                 | -1,290                         | -9                               | 12.4  | 13.3  | 1.4  | 7                                 | 0  |
| Van Buren Co.      | 8,522                  | 7,155                  | -1,367                         | -16                              | 8.8   | 9.2   | 0.6  | 5                                 | 0  |
| Wapello Co.        | 39,385                 | 35,022                 | -4,363                         | -11                              | 13.0  | 19.3  | 9.8  | 48                                | 0  |
| Warren Co.         | 34,727                 | 50,078                 | 15,351                         | 44                               | 15.2  | 21.5  | 9.8  | 41                                | 100  |
| Washington Co.     | 20,064                 | 22,204                 | 2,140                          | 11                               | 13.3  | 19.4  | 9.5  | 46                                | 27   |
| Wayne Co.          | 7,958                  | 6,492                  | -1,466                         | -18                              | 12.6  | 13.0  | 0.6  | 3                                 | 0  |
| Webster Co.        | 44,908                 | 36,637                 | -8,271                         | -18                              | 18.6  | 22.5  | 6.1  | 21                                | 0  |
| Winnebago Co.      | 12,548                 | 10,573                 | -1,975                         | -16                              | 6.6   | 6.2   | -0.6   | -6                                | 0  |

| <b>Iowa County</b>      | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Winneshiek Co.          | 21,817                 | 20,129                 | -1,688                         | -8                               | 15.7  | 18.1  | 3.8  | 15                                | 0  |
| Woodbury Co.            | 100,548                | 102,132                | 1,584                          | 2                                | 44.1  | 59.3  | 23.8   | 34                                | 5  |
| Worth Co.               | 8,951                  | 7,455                  | -1,496                         | -17                              | 8.4   | 9.1   | 1.1  | 8                                 | 0  |
| Wright Co.              | 15,844                 | 12,765                 | -3,079                         | -19                              | 11.7  | 12.0  | 0.5  | 3                                 | 0  |
| <b>Totals</b>           | <b>2,888,190</b>       | <b>3,141,550</b>       | <b>253,360</b>                 | <b>9</b>                         | <b>1,640.8</b>                                | <b>1,964.3</b>                                | <b>505.5</b>   | <b>20</b>                         | <b>47</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>42</b>                                    |



**Scatter Plot for Iowa County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.96**

**Kansas**

| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Allen Co.            | 15,637                 | 12,555                 | -3,082                         | -20                              | 14.9  | 18.2  | 5.2  | 22                                | 0  |
| Anderson Co.         | 8,508                  | 7,833                  | -675                           | -8                               | 10.3  | 11.0  | 1.1  | 7                                 | 0  |
| Atchison Co.         | 18,213                 | 16,298                 | -1,915                         | -11                              | 12.1  | 13.6  | 2.3  | 12                                | 0  |
| Barber Co.           | 6,744                  | 4,570                  | -2,174                         | -32                              | 12.4  | 13.2  | 1.3  | 6                                 | 0  |
| Barton Co.           | 33,038                 | 26,394                 | -6,644                         | -20                              | 24.5  | 25.2  | 1.1  | 3                                 | 0  |
| Bourbon Co.          | 15,833                 | 14,609                 | -1,224                         | -8                               | 14.9  | 17.9  | 4.7  | 20                                | 0  |
| Brown Co.            | 11,560                 | 9,609                  | -1,951                         | -17                              | 12.3  | 13.6  | 2.0  | 11                                | 0  |
| Butler Co.           | 47,208                 | 66,845                 | 19,637                         | 42                               | 35.0  | 61.0  | 40.6   | 74                                | 63   |
| Chase Co.            | 3,187                  | 2,651                  | -536                           | -17                              | 5.4   | 5.3   | -0.2   | -2                                | 0  |
| Chautauqua Co.       | 4,994                  | 3,315                  | -1,679                         | -34                              | 7.7   | 9.0   | 2.0  | 17                                | 0  |
| Cherokee Co.         | 22,177                 | 20,129                 | -2,048                         | -9                               | 20.5  | 23.6  | 4.8  | 15                                | 0  |

| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Cheyenne Co.         | 3,714                  | 2,684                  | -1,030                         | -28                              | 9.6   | 10.2  | 0.9  | 6                                 | 0  |
| Clark Co.            | 2,658                  | 1,995                  | -663                           | -25                              | 8.1   | 8.2   | 0.2  | 1                                 | 0  |
| Clay Co.             | 9,471                  | 8,006                  | -1,465                         | -15                              | 11.3  | 12.3  | 1.6  | 9                                 | 0  |
| Cloud Co.            | 12,125                 | 8,912                  | -3,213                         | -26                              | 12.8  | 14.0  | 1.9  | 9                                 | 0  |
| Coffey Co.           | 9,396                  | 8,228                  | -1,168                         | -12                              | 7.4   | 8.8   | 2.2  | 19                                | 0  |
| Comanche Co.         | 2,501                  | 1,759                  | -742                           | -30                              | 7.1   | 7.9   | 1.3  | 11                                | 0  |
| Cowley Co.           | 37,231                 | 35,297                 | -1,934                         | -5                               | 33.1  | 39.4  | 9.8  | 19                                | 0  |
| Crawford Co.         | 37,792                 | 38,925                 | 1,133                          | 3                                | 26.0  | 38.7  | 19.8   | 49                                | 7  |
| Decatur Co.          | 4,666                  | 2,863                  | -1,803                         | -39                              | 12.1  | 12.6  | 0.8  | 4                                 | 0  |
| Dickinson Co.        | 19,752                 | 18,829                 | -923                           | -5                               | 22.6  | 25.4  | 4.4  | 12                                | 0  |
| Doniphan Co.         | 8,924                  | 7,657                  | -1,267                         | -14                              | 7.2   | 8.2   | 1.6  | 14                                | 0  |
| Douglas Co.          | 69,948                 | 120,281                | 50,333                         | 72                               | 27.6  | 40.3  | 19.8   | 46                                | 100  |

| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Edwards Co.          | 4,097                  | 2,873                  | -1,224                         | -30                              | 9.6   | 10.3  | 1.1  | 7                                 | 0  |
| Elk Co.              | 3,713                  | 2,514                  | -1,199                         | -32                              | 6.2   | 6.4   | 0.3  | 3                                 | 0  |
| Ellis Co.            | 27,588                 | 28,735                 | 1,147                          | 4                                | 19.4  | 34.6  | 23.8   | 78                                | 7  |
| Ellsworth Co.        | 6,536                  | 6,284                  | -252                           | -4                               | 13.0  | 15.8  | 4.4  | 22                                | 0  |
| Finney Co.           | 27,074                 | 36,720                 | 9,646                          | 36                               | 31.1  | 42.2  | 17.3   | 36                                | 100  |
| Ford Co.             | 25,550                 | 34,218                 | 8,668                          | 34                               | 20.4  | 27.7  | 11.4   | 36                                | 95   |
| Franklin Co.         | 21,751                 | 25,631                 | 3,880                          | 18                               | 19.0  | 25.0  | 9.4  | 32                                | 60   |
| Geary Co.            | 31,099                 | 33,774                 | 2,675                          | 9                                | 10.9  | 13.3  | 3.8  | 22                                | 41   |
| Gove Co.             | 3,654                  | 2,622                  | -1,032                         | -28                              | 10.8  | 13.2  | 3.8  | 22                                | 0  |
| Graham Co.           | 4,171                  | 2,485                  | -1,686                         | -40                              | 10.0  | 10.4  | 0.6  | 4                                 | 0  |
| Grant Co.            | 6,748                  | 7,490                  | 742                            | 11                               | 9.9   | 12.8  | 4.5  | 29                                | 41   |
| Gray Co.             | 5,198                  | 6,018                  | 820                            | 16                               | 11.3  | 13.0  | 2.7  | 15                                | 100  |

| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Greeley Co.          | 1,792                  | 1,226                  | -566                           | -32                              | 6.9   | 7.4   | 0.8  | 7                                 | 0  |
| Greenwood Co.        | 8,796                  | 6,067                  | -2,729                         | -31                              | 13.5  | 13.4  | -0.2   | -1                                | 0  |
| Hamilton Co.         | 2,458                  | 2,616                  | 158                            | 6                                | 10.5  | 9.9   | -0.9   | -6                                | 0  |
| Harper Co.           | 7,646                  | 5,580                  | -2,066                         | -27                              | 13.1  | 13.6  | 0.8  | 4                                 | 0  |
| Harvey Co.           | 31,047                 | 34,373                 | 3,326                          | 11                               | 18.9  | 24.5  | 8.8  | 30                                | 39   |
| Haskell Co.          | 3,815                  | 4,019                  | 204                            | 5                                | 7.9   | 9.1   | 1.9  | 15                                | 37   |
| Hodgeman Co.         | 2,223                  | 1,863                  | -360                           | -16                              | 8.8   | 9.3   | 0.8  | 6                                 | 0  |
| Jackson Co.          | 11,424                 | 13,332                 | 1,908                          | 17                               | 10.3  | 13.7  | 5.3  | 33                                | 54   |
| Jefferson Co.        | 15,224                 | 18,932                 | 3,708                          | 24                               | 14.3  | 17.0  | 4.2  | 19                                | 100  |
| Jewell Co.           | 5,069                  | 2,857                  | -2,212                         | -44                              | 12.2  | 12.7  | 0.8  | 4                                 | 0  |
| Johnson Co.          | 279,533                | 591,305                | 311,772                        | 112                              | 81.2  | 141.1   | 93.6   | 74                                | 100  |
| Kearny Co.           | 3,819                  | 3,935                  | 116                            | 3                                | 8.3   | 9.0   | 1.1  | 8                                 | 37   |

| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Kingman Co.          | 8,813                  | 7,275                  | -1,538                         | -17                              | 16.4  | 18.4  | 3.1  | 12                                | 0  |
| Kiowa Co.            | 4,098                  | 2,486                  | -1,612                         | -39                              | 13.6  | 14.2  | 0.9  | 4                                 | 0  |
| Labette Co.          | 25,507                 | 20,129                 | -5,378                         | -21                              | 17.9  | 19.3  | 2.2  | 8                                 | 0  |
| Lane Co.             | 2,485                  | 1,548                  | -937                           | -38                              | 6.1   | 6.7   | 0.9  | 10                                | 0  |
| Leavenworth Co.      | 57,234                 | 81,109                 | 23,875                         | 42                               | 20.3  | 36.7  | 25.6   | 81                                | 59   |
| Lincoln Co.          | 4,065                  | 3,043                  | -1,022                         | -25                              | 9.4   | 10.7  | 2.0  | 14                                | 0  |
| Linn Co.             | 8,020                  | 9,697                  | 1,677                          | 21                               | 12.0  | 14.0  | 3.1  | 17                                | 100  |
| Logan Co.            | 3,453                  | 2,814                  | -639                           | -19                              | 9.9   | 11.8  | 3.0  | 19                                | 0  |
| Lyon Co.             | 36,688                 | 33,257                 | -3,431                         | -9                               | 18.8  | 22.4  | 5.6  | 19                                | 0  |
| McPherson Co.        | 27,215                 | 28,687                 | 1,472                          | 5                                | 24.5  | 28.8  | 6.7  | 18                                | 33   |
| Marion Co.           | 13,171                 | 11,945                 | -1,226                         | -9                               | 15.8  | 17.3  | 2.3  | 9                                 | 0  |
| Marshall Co.         | 12,721                 | 9,687                  | -3,034                         | -24                              | 13.7  | 14.7  | 1.6  | 7                                 | 0  |

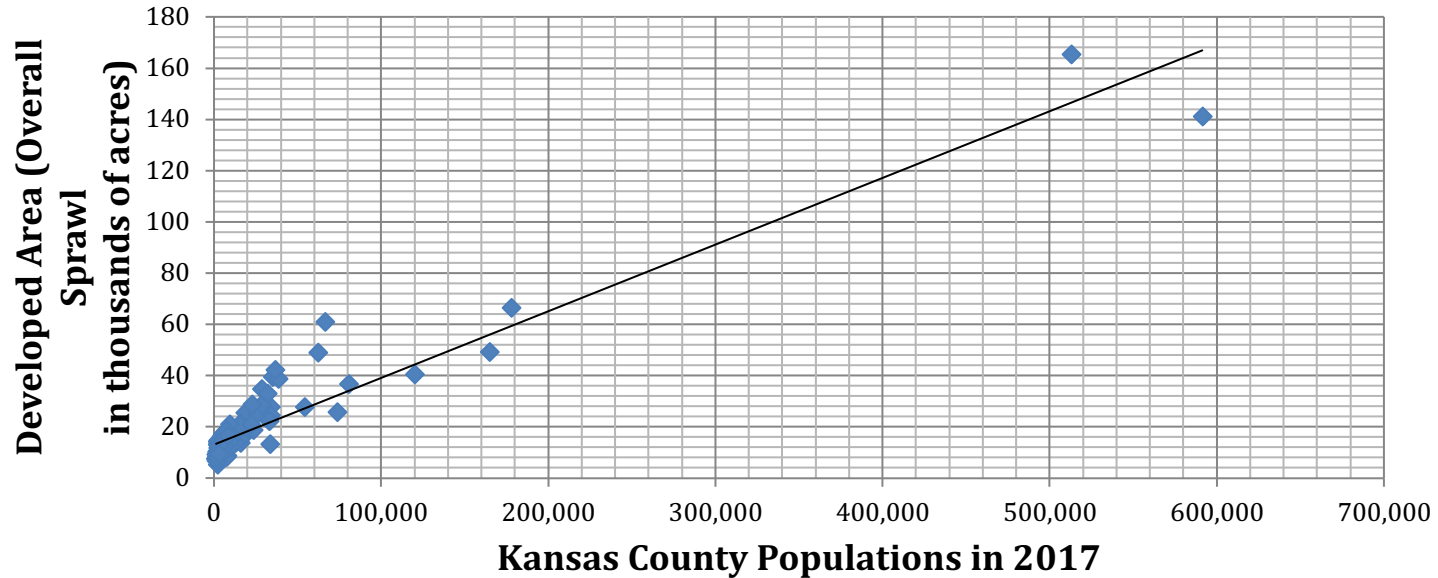
| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Meade Co.            | 4,753                  | 4,230                  | -523                           | -11                              | 11.9  | 12.1  | 0.3  | 2                                 | 0  |
| Miami Co.            | 21,788                 | 33,429                 | 11,641                         | 53                               | 14.8  | 22.2  | 11.6   | 50                                | 100  |
| Mitchell Co.         | 7,917                  | 6,137                  | -1,780                         | -22                              | 12.8  | 15.0  | 3.4  | 17                                | 0  |
| Montgomery Co.       | 43,286                 | 32,390                 | -10,896                        | -25                              | 28.8  | 33.0  | 6.6  | 15                                | 0  |
| Morris Co.           | 6,271                  | 5,467                  | -804                           | -13                              | 12.3  | 13.1  | 1.3  | 7                                 | 0  |
| Morton Co.           | 3,505                  | 2,747                  | -758                           | -22                              | 9.3   | 9.5   | 0.3  | 2                                 | 0  |
| Nemaha Co.           | 10,897                 | 10,060                 | -837                           | -8                               | 11.9  | 12.3  | 0.6  | 3                                 | 0  |
| Neosho Co.           | 19,394                 | 16,094                 | -3,300                         | -17                              | 19.6  | 21.4  | 2.8  | 9                                 | 0  |
| Ness Co.             | 4,655                  | 2,856                  | -1,799                         | -39                              | 13.2  | 14.6  | 2.2  | 11                                | 0  |
| Norton Co.           | 6,538                  | 5,421                  | -1,117                         | -17                              | 13.5  | 17.1  | 5.6  | 27                                | 0  |
| Osage Co.            | 15,384                 | 15,842                 | 458                            | 3                                | 16.8  | 20.4  | 5.6  | 21                                | 15   |
| Osborne Co.          | 5,696                  | 3,539                  | -2,157                         | -38                              | 10.0  | 11.2  | 1.9  | 12                                | 0  |

| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Ottawa Co.           | 5,798                  | 5,817                  | 19                             | 0                                | 11.2  | 11.8  | 0.9  | 5                                 | 6  |
| Pawnee Co.           | 8,131                  | 6,665                  | -1,466                         | -18                              | 13.2  | 13.6  | 0.6  | 3                                 | 0  |
| Phillips Co.         | 7,232                  | 5,370                  | -1,862                         | -26                              | 13.5  | 14.2  | 1.1  | 5                                 | 0  |
| Pottawatomie Co.     | 15,264                 | 23,916                 | 8,652                          | 57                               | 16.0  | 18.7  | 4.2  | 17                                | 100  |
| Pratt Co.            | 10,673                 | 9,500                  | -1,173                         | -11                              | 11.9  | 13.9  | 3.1  | 17                                | 0  |
| Rawlins Co.          | 4,093                  | 2,473                  | -1,620                         | -40                              | 9.9   | 10.5  | 0.9  | 6                                 | 0  |
| Reno Co.             | 64,352                 | 62,714                 | -1,638                         | -3                               | 38.4  | 48.8  | 16.3   | 27                                | 0  |
| Republic Co.         | 7,183                  | 4,654                  | -2,529                         | -35                              | 16.5  | 16.1  | -0.6   | -2                                | 0  |
| Rice Co.             | 11,557                 | 9,563                  | -1,994                         | -17                              | 19.8  | 21.0  | 1.9  | 6                                 | 0  |
| Riley Co.            | 65,462                 | 73,977                 | 8,515                          | 13                               | 15.9  | 25.7  | 15.3   | 62                                | 25   |
| Rooks Co.            | 7,203                  | 5,055                  | -2,148                         | -30                              | 14.1  | 14.5  | 0.6  | 3                                 | 0  |
| Rush Co.             | 4,428                  | 3,048                  | -1,380                         | -31                              | 11.9  | 12.5  | 0.9  | 5                                 | 0  |

| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Russell Co.          | 9,121                  | 6,930                  | -2,191                         | -24                              | 15.7  | 16.7  | 1.6  | 6                                 | 0  |
| Saline Co.           | 49,234                 | 54,508                 | 5,274                          | 11                               | 24.9  | 27.8  | 4.5  | 12                                | 92   |
| Scott Co.            | 5,723                  | 4,928                  | -795                           | -14                              | 8.8   | 11.8  | 4.7  | 34                                | 0  |
| Sedgwick Co.         | 377,352                | 513,176                | 135,824                        | 36                               | 116.0   | 165.3   | 77.0   | 43                                | 87   |
| Seward Co.           | 18,652                 | 22,245                 | 3,593                          | 19                               | 17.6  | 21.0  | 5.3  | 19                                | 100  |
| Shawnee Co.          | 156,184                | 178,056                | 21,872                         | 14                               | 47.4  | 66.4  | 29.7   | 40                                | 39   |
| Sheridan Co.         | 3,402                  | 2,526                  | -876                           | -26                              | 8.5   | 8.4   | -0.2   | -1                                | 0  |
| Sherman Co.          | 7,474                  | 5,936                  | -1,538                         | -21                              | 12.1  | 12.2  | 0.2  | 1                                 | 0  |
| Smith Co.            | 5,692                  | 3,615                  | -2,077                         | -36                              | 10.9  | 12.6  | 2.7  | 16                                | 0  |
| Stafford Co.         | 5,834                  | 4,186                  | -1,648                         | -28                              | 10.7  | 11.8  | 1.7  | 10                                | 0  |
| Stanton Co.          | 2,337                  | 2,055                  | -282                           | -12                              | 9.3   | 10.1  | 1.3  | 9                                 | 0  |
| Stevens Co.          | 4,670                  | 5,551                  | 881                            | 19                               | 11.8  | 13.7  | 3.0  | 16                                | 100  |

| <b>Kansas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Sumner Co.           | 25,463                 | 23,117                 | -2,346                         | -9                               | 27.0  | 28.6  | 2.5  | 6                                 | 0  |
| Thomas Co.           | 8,586                  | 7,821                  | -765                           | -9                               | 17.8  | 18.4  | 0.9  | 3                                 | 0  |
| Trego Co.            | 4,214                  | 2,843                  | -1,371                         | -33                              | 11.3  | 11.8  | 0.8  | 4                                 | 0  |
| Wabaunsee Co.        | 6,653                  | 6,832                  | 179                            | 3                                | 10.5  | 12.5  | 3.1  | 19                                | 15   |
| Wallace Co.          | 1,978                  | 1,515                  | -463                           | -23                              | 8.8   | 9.3   | 0.8  | 6                                 | 0  |
| Washington Co.       | 8,150                  | 5,479                  | -2,671                         | -33                              | 14.6  | 13.9  | -1.1   | -5                                | 0  |
| Wichita Co.          | 2,957                  | 2,121                  | -836                           | -28                              | 7.1   | 8.0   | 1.4  | 13                                | 0  |
| Wilson Co.           | 11,718                 | 8,707                  | -3,011                         | -26                              | 12.4  | 16.4  | 6.3  | 32                                | 0  |
| Woodson Co.          | 4,590                  | 3,130                  | -1,460                         | -32                              | 8.6   | 9.5   | 1.4  | 10                                | 0  |
| Wyandotte Co.        | 170,991                | 165,087                | -5,904                         | -3                               | 45.5  | 49.1  | 5.6  | 8                                 | 0  |
| <b>Totals</b>        | <b>2,401,207</b>       | <b>2,908,718</b>       | <b>507,511</b>                 | <b>21</b>                        | <b>1,735.3</b>                                | <b>2,136.5</b>                                | <b>626.9</b>   | <b>23</b>                         | <b>92</b>                                    |

| Kansas County           | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Weighted Average</b> |                 |                 |                         |                           |  |  |   |                            | <b>52</b>                             |



**Scatter Plot for Kansas County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

R-value: 0.95

**Kentucky**

| Kentucky County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Adair Co.       | 15,438          | 19,287          | 3,849                   | 25                        | 5.3                                    | 9.6                                    | 6.7   | 81                         | 37                                    |
| Allen Co.       | 13,917          | 20,903          | 6,986                   | 50                        | 4.9                                    | 11.0                                   | 9.5   | 124                        | 50                                    |
| Anderson Co.    | 12,850          | 22,545          | 9,695                   | 75                        | 5.4                                    | 11.6                                   | 9.7   | 115                        | 74                                    |
| Ballard Co.     | 8,490           | 8,018           | -472                    | -6                        | 4.3                                    | 6.8                                    | 3.9   | 58                         | 0                                     |
| Barren Co.      | 34,630          | 43,746          | 9,116                   | 26                        | 13.1                                   | 23.7                                   | 16.6  | 81                         | 39                                    |
| Bath Co.        | 10,090          | 12,381          | 2,291                   | 23                        | 2.6                                    | 7.9                                    | 8.3   | 204                        | 18                                    |
| Bell Co.        | 34,072          | 26,863          | -7,209                  | -21                       | 10.5                                   | 16.8                                   | 9.8   | 60                         | 0                                     |
| Boone Co.       | 47,769          | 130,952         | 83,183                  | 174                       | 17.0                                   | 46.9                                   | 46.7  | 176                        | 99                                    |
| Bourbon Co.     | 19,027          | 20,092          | 1,065                   | 6                         | 6.6                                    | 11.4                                   | 7.5   | 73                         | 10                                    |
| Boyd Co.        | 54,541          | 47,808          | -6,733                  | -12                       | 17.6                                   | 24.1                                   | 10.2  | 37                         | 0                                     |
| Boyle Co.       | 24,586          | 29,972          | 5,386                   | 22                        | 8.8                                    | 13.7                                   | 7.7   | 56                         | 45                                    |

| Kentucky County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Bracken Co.      | 7,604           | 8,285           | 681                     | 9                         | 3.5                                    | 5.8                                    | 3.6   | 66                         | 17                                    |
| Breathitt Co.    | 16,770          | 12,929          | -3,841                  | -23                       | 6.2                                    | 10.1                                   | 6.1   | 63                         | 0                                     |
| Breckinridge Co. | 16,607          | 20,131          | 3,524                   | 21                        | 10.0                                   | 17.0                                   | 10.9  | 70                         | 36                                    |
| Bullitt Co.      | 43,629          | 80,269          | 36,640                  | 84                        | 17.0                                   | 38.6                                   | 33.8  | 127                        | 74                                    |
| Butler Co.       | 11,001          | 12,778          | 1,777                   | 16                        | 5.4                                    | 10.3                                   | 7.7   | 91                         | 23                                    |
| Caldwell Co.     | 13,583          | 12,666          | -917                    | -7                        | 8.8                                    | 13.3                                   | 7.0   | 51                         | 0                                     |
| Calloway Co.     | 30,221          | 38,832          | 8,611                   | 28                        | 12.4                                   | 25.5                                   | 20.5  | 106                        | 35                                    |
| Campbell Co.     | 83,347          | 92,878          | 9,531                   | 11                        | 15.1                                   | 27.9                                   | 20.0  | 85                         | 18                                    |
| Carlisle Co.     | 5,444           | 4,788           | -656                    | -12                       | 3.8                                    | 5.3                                    | 2.3   | 39                         | 0                                     |
| Carroll Co.      | 9,505           | 10,714          | 1,209                   | 13                        | 5.7                                    | 10.2                                   | 7.0   | 79                         | 21                                    |
| Carter Co.       | 25,238          | 27,214          | 1,976                   | 8                         | 9.0                                    | 16.9                                   | 12.3  | 88                         | 12                                    |
| Casey Co.        | 15,154          | 15,818          | 664                     | 4                         | 3.9                                    | 7.8                                    | 6.1   | 100                        | 6                                     |

| Kentucky County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Christian Co.   | 68,283          | 71,024          | 2,741                   | 4                         | 25.8                                   | 42.7                                   | 26.4  | 66                         | 8                                     |
| Clark Co.       | 28,752          | 35,899          | 7,147                   | 25                        | 11.1                                   | 16.8                                   | 8.9   | 51                         | 54                                    |
| Clay Co.        | 22,996          | 20,251          | -2,745                  | -12                       | 6.3                                    | 12.3                                   | 9.4   | 95                         | 0                                     |
| Clinton Co.     | 9,497           | 10,212          | 715                     | 8                         | 3.1                                    | 6.5                                    | 5.3   | 110                        | 10                                    |
| Crittenden Co.  | 9,129           | 8,999           | -130                    | -1                        | 4.0                                    | 5.4                                    | 2.2   | 35                         | 0                                     |
| Cumberland Co.  | 7,286           | 6,710           | -576                    | -8                        | 2.3                                    | 4.1                                    | 2.8   | 78                         | 0                                     |
| Daviess Co.     | 86,822          | 100,461         | 13,639                  | 16                        | 17.5                                   | 28.8                                   | 17.7  | 65                         | 29                                    |
| Edmonson Co.    | 10,357          | 12,226          | 1,869                   | 18                        | 5.6                                    | 9.3                                    | 5.8   | 66                         | 33                                    |
| Elliott Co.     | 6,847           | 7,493           | 646                     | 9                         | 1.9                                    | 3.4                                    | 2.3   | 79                         | 15                                    |
| Estill Co.      | 14,547          | 14,178          | -369                    | -3                        | 3.4                                    | 5.9                                    | 3.9   | 74                         | 0                                     |
| Fayette Co.     | 207,987         | 321,964         | 113,977                 | 55                        | 45.1                                   | 72.5                                   | 42.8  | 61                         | 92                                    |
| Fleming Co.     | 12,553          | 14,439          | 1,886                   | 15                        | 5.7                                    | 10.6                                   | 7.7   | 86                         | 23                                    |

| <b>Kentucky County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Floyd Co.              | 48,742                 | 36,296                 | -12,446                        | -26                              | 8.2   | 18.8  | 16.6   | 129                               | 0  |
| Franklin Co.           | 42,514                 | 50,492                 | 7,978                          | 19                               | 8.8   | 20.5  | 18.3   | 133                               | 20   |
| Fulton Co.             | 8,849                  | 6,163                  | -2,686                         | -30                              | 4.7   | 6.2   | 2.3  | 32                                | 0  |
| Gallatin Co.           | 4,743                  | 8,720                  | 3,977                          | 84                               | 1.7   | 4.6   | 4.5  | 171                               | 61   |
| Garrard Co.            | 11,203                 | 17,449                 | 6,246                          | 56                               | 2.1   | 9.8   | 12.0   | 367                               | 29   |
| Grant Co.              | 13,539                 | 24,973                 | 11,434                         | 84                               | 9.2   | 21.1  | 18.6   | 129                               | 74   |
| Graves Co.             | 33,744                 | 37,190                 | 3,446                          | 10                               | 13.5  | 21.3  | 12.2   | 58                                | 21   |
| Grayson Co.            | 21,103                 | 26,286                 | 5,183                          | 25                               | 13.5  | 21.1  | 11.9   | 56                                | 49   |
| Green Co.              | 10,816                 | 11,036                 | 220                            | 2                                | 5.2   | 7.7   | 3.9  | 48                                | 5  |
| Greenup Co.            | 38,483                 | 35,514                 | -2,969                         | -8                               | 12.7  | 20.6  | 12.3   | 62                                | 0  |
| Hancock Co.            | 7,974                  | 8,778                  | 804                            | 10                               | 5.2   | 8.7   | 5.5  | 67                                | 19   |
| Hardin Co.             | 86,113                 | 108,161                | 22,048                         | 26                               | 21.5  | 49.6  | 43.9   | 131                               | 27   |

| <b>Kentucky County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Harlan Co.             | 42,460                 | 26,676                 | -15,784                        | -37                              | 10.8  | 16.4  | 8.8  | 52                                | 0  |
| Harrison Co.           | 15,433                 | 18,735                 | 3,302                          | 21                               | 4.6   | 8.9   | 6.7  | 93                                | 29   |
| Hart Co.               | 15,592                 | 18,745                 | 3,153                          | 20                               | 9.3   | 14.4  | 8.0  | 55                                | 42   |
| Henderson Co.          | 41,582                 | 45,867                 | 4,285                          | 10                               | 16.5  | 23.1  | 10.3   | 40                                | 29   |
| Henry Co.              | 12,865                 | 15,972                 | 3,107                          | 24                               | 4.0   | 6.6   | 4.1  | 65                                | 43   |
| Hickman Co.            | 5,992                  | 4,518                  | -1,474                         | -25                              | 2.6   | 3.1   | 0.8  | 19                                | 0  |
| Hopkins Co.            | 46,774                 | 45,293                 | -1,481                         | -3                               | 19.8  | 29.5  | 15.2   | 49                                | 0  |
| Jackson Co.            | 12,171                 | 13,422                 | 1,251                          | 10                               | 2.7   | 4.8   | 3.3  | 78                                | 17   |
| Jefferson Co.          | 681,903                | 769,828                | 87,925                         | 13                               | 96.7  | 168.6   | 112.3  | 74                                | 22   |
| Jessamine Co.          | 26,759                 | 53,259                 | 26,500                         | 99                               | 10.3  | 20.6  | 16.1   | 100                               | 99   |
| Johnson Co.            | 24,865                 | 22,606                 | -2,259                         | -9                               | 6.2   | 12.6  | 10.0   | 103                               | 0  |
| Kenton Co.             | 137,627                | 165,608                | 27,981                         | 20                               | 24.6  | 43.3  | 29.2   | 76                                | 33   |

| <b>Kentucky County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Knott Co.              | 18,294                 | 15,244                 | -3,050                         | -17                              | 4.6   | 10.6  | 9.4  | 130                               | 0  |
| Knox Co.               | 30,302                 | 31,444                 | 1,142                          | 4                                | 13.2  | 28.4  | 23.8   | 115                               | 5  |
| Larue Co.              | 11,798                 | 14,196                 | 2,398                          | 20                               | 4.4   | 8.8   | 6.9  | 100                               | 27   |
| Laurel Co.             | 40,456                 | 60,317                 | 19,861                         | 49                               | 20.4  | 45.0  | 38.4   | 121                               | 50   |
| Lawrence Co.           | 14,391                 | 15,756                 | 1,365                          | 9                                | 2.5   | 8.3   | 9.1  | 232                               | 8  |
| Lee Co.                | 7,661                  | 6,602                  | -1,059                         | -14                              | 2.4   | 5.1   | 4.2  | 113                               | 0  |
| Leslie Co.             | 14,978                 | 10,310                 | -4,668                         | -31                              | 2.8   | 7.4   | 7.2  | 164                               | 0  |
| Letcher Co.            | 30,416                 | 22,303                 | -8,113                         | -27                              | 6.0   | 14.9  | 13.9   | 148                               | 0  |
| Lewis Co.              | 14,572                 | 13,363                 | -1,209                         | -8                               | 5.9   | 9.2   | 5.2  | 56                                | 0  |
| Lincoln Co.            | 19,079                 | 24,495                 | 5,416                          | 28                               | 10.0  | 18.5  | 13.3   | 85                                | 41   |
| Livingston Co.         | 9,313                  | 9,249                  | -64                            | -1                               | 5.1   | 7.2   | 3.3  | 41                                | 0  |
| Logan Co.              | 24,857                 | 27,003                 | 2,146                          | 9                                | 14.6  | 22.6  | 12.5   | 55                                | 19   |

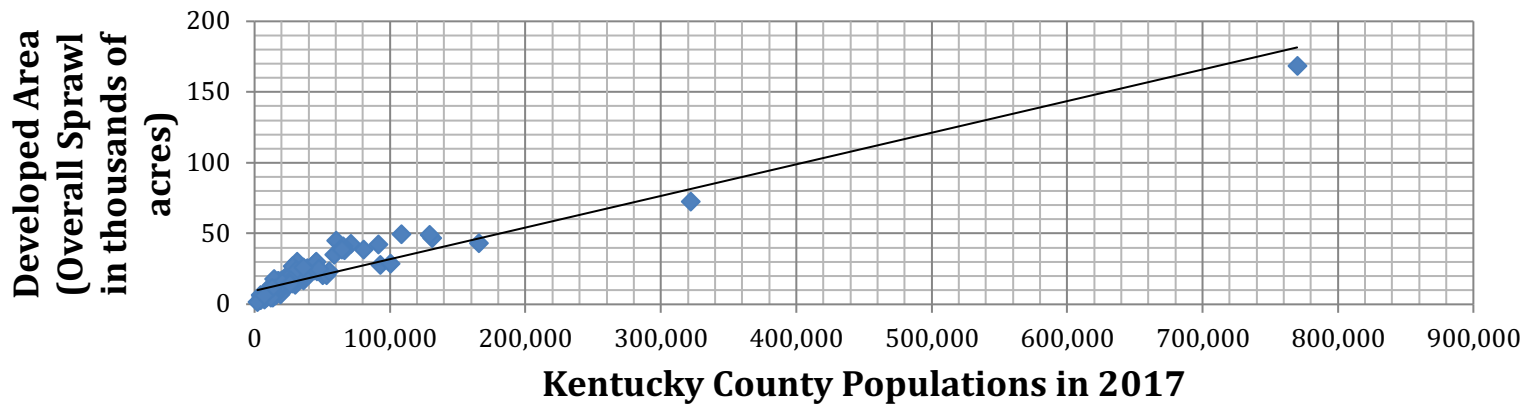
| Kentucky County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Lyon Co.        | 6,437           | 8,261           | 1,824                   | 28                        | 4.1                                    | 8.5                                    | 6.9   | 107                        | 34                                    |
| McCracken Co.   | 61,682          | 65,364          | 3,682                   | 6                         | 24.6                                   | 40.9                                   | 25.5  | 66                         | 11                                    |
| McCreary Co.    | 16,021          | 17,372          | 1,351                   | 8                         | 7.9                                    | 16.6                                   | 13.6  | 110                        | 11                                    |
| McLean Co.      | 9,935           | 9,216           | -719                    | -7                        | 4.9                                    | 9.3                                    | 6.9   | 90                         | 0                                     |
| Madison Co.     | 53,608          | 91,170          | 37,562                  | 70                        | 20.0                                   | 42.2                                   | 34.7  | 111                        | 71                                    |
| Magoffin Co.    | 13,756          | 12,519          | -1,237                  | -9                        | 3.3                                    | 6.3                                    | 4.7   | 91                         | 0                                     |
| Marion Co.      | 17,551          | 19,276          | 1,725                   | 10                        | 3.0                                    | 7.1                                    | 6.4   | 137                        | 11                                    |
| Marshall Co.    | 25,795          | 31,318          | 5,523                   | 21                        | 16.1                                   | 30.2                                   | 22.0  | 88                         | 31                                    |
| Martin Co.      | 14,238          | 11,492          | -2,746                  | -19                       | 2.8                                    | 7.9                                    | 8.0   | 182                        | 0                                     |
| Mason Co.       | 17,897          | 17,192          | -705                    | -4                        | 6.3                                    | 10.8                                   | 7.0   | 71                         | 0                                     |
| Meade Co.       | 22,894          | 28,033          | 5,139                   | 22                        | 15.0                                   | 26.9                                   | 18.6  | 79                         | 35                                    |
| Menifee Co.     | 5,272           | 6,465           | 1,193                   | 23                        | 2.0                                    | 4.8                                    | 4.4   | 140                        | 23                                    |

| <b>Kentucky County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Mercer Co.             | 18,858                 | 21,542                 | 2,684                          | 14                               | 8.2   | 13.2  | 7.8  | 61                                | 28   |
| Metcalf Co.            | 9,537                  | 10,093                 | 556                            | 6                                | 4.6   | 8.7   | 6.4  | 89                                | 9  |
| Monroe Co.             | 12,262                 | 10,597                 | -1,665                         | -14                              | 5.5   | 7.9   | 3.8  | 44                                | 0  |
| Montgomery Co.         | 20,083                 | 27,913                 | 7,830                          | 39                               | 6.6   | 14.8  | 12.8   | 124                               | 41   |
| Morgan Co.             | 12,137                 | 13,230                 | 1,093                          | 9                                | 4.0   | 7.9   | 6.1  | 98                                | 13   |
| Muhlenberg Co.         | 32,698                 | 30,925                 | -1,773                         | -5                               | 14.8  | 24.0  | 14.4   | 62                                | 0  |
| Nelson Co.             | 27,977                 | 45,591                 | 17,614                         | 63                               | 10.7  | 30.0  | 30.2   | 180                               | 47   |
| Nicholas Co.           | 7,077                  | 7,160                  | 83                             | 1                                | 2.7   | 4.8   | 3.3  | 78                                | 2  |
| Ohio Co.               | 21,425                 | 24,116                 | 2,691                          | 13                               | 12.2  | 18.1  | 9.2  | 48                                | 30   |
| Oldham Co.             | 28,715                 | 66,557                 | 37,842                         | 132                              | 17.3  | 38.1  | 32.5   | 120                               | 100  |
| Owen Co.               | 9,026                  | 10,794                 | 1,768                          | 20                               | 5.6   | 11.1  | 8.6  | 98                                | 26   |
| Owsley Co.             | 5,585                  | 4,402                  | -1,183                         | -21                              | 3.2   | 6.4   | 5.0  | 100                               | 0  |

| <b>Kentucky County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Pendleton Co.          | 10,836                 | 14,602                 | 3,766                          | 35                               | 3.5   | 5.9   | 3.8  | 69                                | 57   |
| Perry Co.              | 33,670                 | 26,586                 | -7,084                         | -21                              | 6.7   | 17.2  | 16.4   | 157                               | 0  |
| Pike Co.               | 81,128                 | 58,905                 | -22,223                        | -27                              | 15.1  | 35.2  | 31.4   | 133                               | 0  |
| Powell Co.             | 11,345                 | 12,297                 | 952                            | 8                                | 4.2   | 9.1   | 7.7  | 117                               | 10   |
| Pulaski Co.            | 46,788                 | 64,314                 | 17,526                         | 37                               | 23.3  | 38.7  | 24.1   | 66                                | 63   |
| Robertson Co.          | 2,272                  | 2,120                  | -152                           | -7                               | 0.9   | 1.6   | 1.1  | 78                                | 0  |
| Rockcastle Co.         | 14,035                 | 16,778                 | 2,743                          | 20                               | 5.2   | 14.5  | 14.5   | 179                               | 17   |
| Rowan Co.              | 19,442                 | 24,514                 | 5,072                          | 26                               | 4.9   | 13.7  | 13.8   | 180                               | 23   |
| Russell Co.            | 14,455                 | 17,723                 | 3,268                          | 23                               | 6.2   | 16.5  | 16.1   | 166                               | 21   |
| Scott Co.              | 21,883                 | 54,782                 | 32,899                         | 150                              | 8.0   | 23.3  | 23.9   | 191                               | 86   |
| Shelby Co.             | 23,701                 | 47,209                 | 23,508                         | 99                               | 10.4  | 25.2  | 23.1   | 142                               | 78   |
| Simpson Co.            | 14,607                 | 18,046                 | 3,439                          | 24                               | 3.8   | 9.6   | 9.1  | 153                               | 23   |

| Kentucky County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Spencer Co.     | 5,808           | 18,619          | 12,811                  | 221                       | 2.1                                    | 12.2                                   | 15.8  | 481                        | 66                                    |
| Taylor Co.      | 20,967          | 25,544          | 4,577                   | 22                        | 6.8                                    | 14.7                                   | 12.3  | 116                        | 26                                    |
| Todd Co.        | 11,501          | 12,177          | 676                     | 6                         | 7.1                                    | 11.7                                   | 7.2   | 65                         | 11                                    |
| Trigg Co.       | 9,519           | 14,418          | 4,899                   | 51                        | 10.0                                   | 17.7                                   | 12.0  | 77                         | 73                                    |
| Trimble Co.     | 6,233           | 8,521           | 2,288                   | 37                        | 3.3                                    | 6.0                                    | 4.2   | 82                         | 52                                    |
| Union Co.       | 17,838          | 14,620          | -3,218                  | -18                       | 9.3                                    | 10.9                                   | 2.5   | 17                         | 0                                     |
| Warren Co.      | 79,600          | 129,074         | 49,474                  | 62                        | 24.1                                   | 49.1                                   | 39.1  | 104                        | 68                                    |
| Washington Co.  | 10,568          | 11,880          | 1,312                   | 12                        | 3.4                                    | 4.9                                    | 2.3   | 44                         | 32                                    |
| Wayne Co.       | 17,318          | 20,628          | 3,310                   | 19                        | 3.8                                    | 15.0                                   | 17.5  | 295                        | 13                                    |
| Webster Co.     | 14,681          | 13,012          | -1,669                  | -11                       | 7.2                                    | 11.5                                   | 6.7   | 60                         | 0                                     |
| Whitley Co.     | 33,543          | 36,074          | 2,531                   | 8                         | 12.2                                   | 26.0                                   | 21.6  | 113                        | 10                                    |
| Wolfe Co.       | 6,835           | 7,248           | 413                     | 6                         | 2.8                                    | 6.0                                    | 5.0   | 114                        | 8                                     |

| Kentucky County         | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Woodford Co.            | 17,878           | 26,385           | 8,507                   | 48                        | 7.8                                    | 14.4                                   | 10.3  | 85                         | 63                                    |
| <b>Totals</b>           | <b>3,683,449</b> | <b>4,452,268</b> | <b>768,819</b>          | <b>21</b>                 | <b>1,132.5</b>                         | <b>2,145.5</b>                         | <b>1,582.8</b>                                    | <b>89</b>                  | <b>30</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>35</b>                             |



**Scatter Plot for Kentucky County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.9**

**Louisiana**

| <b>Louisiana Parish</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Acadia Par.             | 58,557                 | 62,559                 | 4,002                          | 7                                | 18.2  | 32.5  | 22.3   | 79                                | 11   |
| Allen Par.              | 21,709                 | 25,583                 | 3,874                          | 18                               | 8.8   | 14.7  | 9.2  | 67                                | 32   |
| Ascension Par.          | 53,056                 | 123,177                | 70,121                         | 132                              | 22.8  | 51.1  | 44.2   | 124                               | 100  |
| Assumption Par.         | 23,542                 | 22,568                 | -974                           | -4                               | 10.7  | 15.5  | 7.5  | 45                                | 0  |
| Avoyelles Par.          | 42,113                 | 40,836                 | -1,277                         | -3                               | 18.6  | 28.4  | 15.3   | 53                                | 0  |
| Beauregard Par.         | 30,845                 | 36,847                 | 6,002                          | 19                               | 14.2  | 26.2  | 18.8   | 85                                | 29   |
| Bienville Par.          | 16,382                 | 13,631                 | -2,751                         | -17                              | 13.7  | 16.1  | 3.8  | 18                                | 0  |
| Bossier Par.            | 86,020                 | 126,959                | 40,939                         | 48                               | 33.2  | 49.3  | 25.2   | 48                                | 98   |
| Caddo Par.              | 258,049                | 245,935                | -12,114                        | -5                               | 72.9  | 102.1   | 45.6   | 40                                | 0  |
| Calcasieu Par.          | 173,969                | 202,466                | 28,497                         | 16                               | 49.9  | 84.5  | 54.1   | 69                                | 29   |
| Caldwell Par.           | 10,710                 | 9,959                  | -751                           | -7                               | 7.1   | 9.3   | 3.4  | 31                                | 0  |

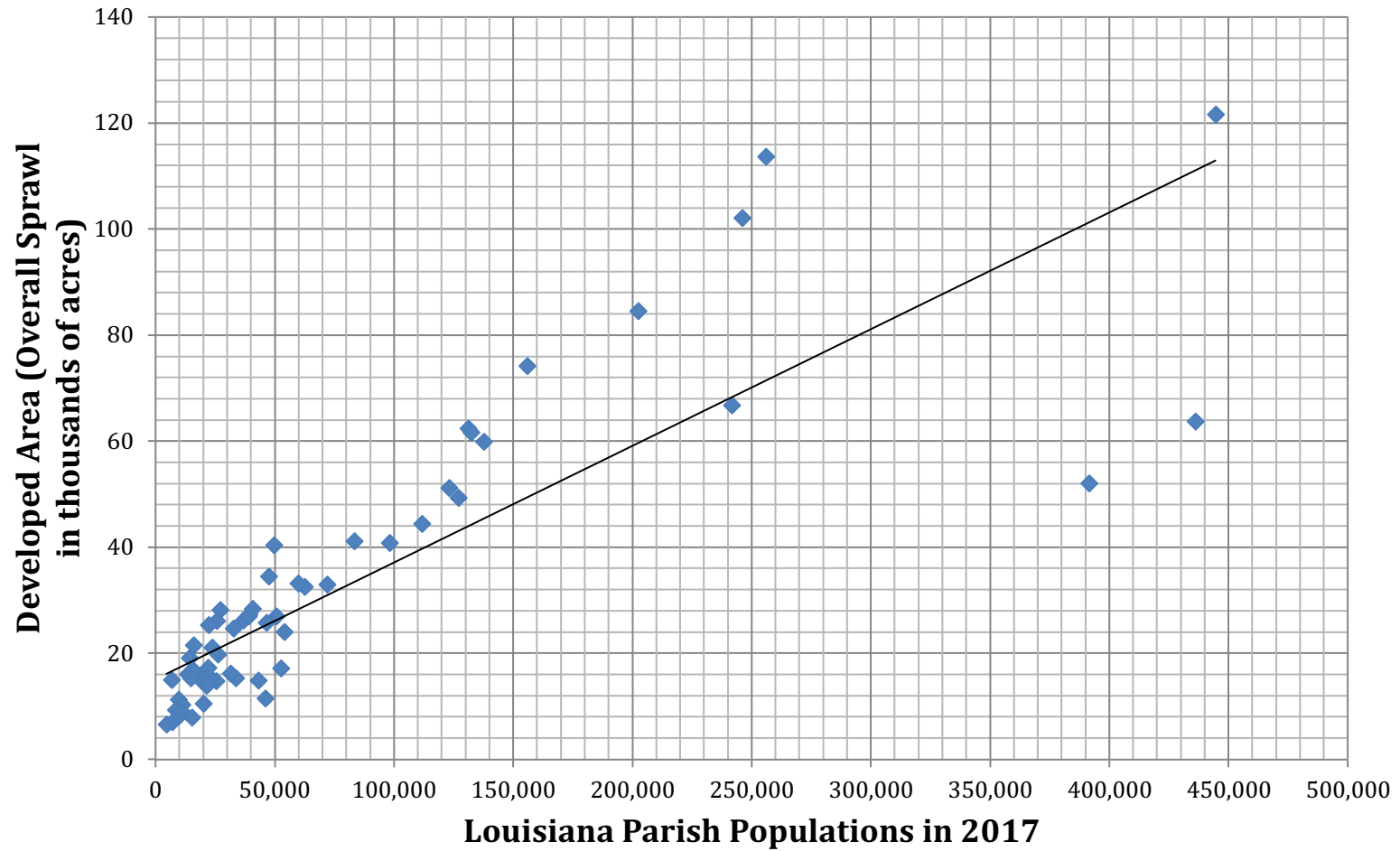
| Louisiana Parish      | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Cameron Par.          | 9,896           | 6,944           | -2,952                  | -30                       | 10.2                                   | 15.0                                   | 7.5   | 47                         | 0                                     |
| Catahoula Par.        | 12,139          | 9,830           | -2,309                  | -19                       | 7.1                                    | 11.3                                   | 6.6   | 59                         | 0                                     |
| Claiborne Par.        | 18,185          | 15,953          | -2,232                  | -12                       | 15.5                                   | 21.5                                   | 9.4   | 39                         | 0                                     |
| Concordia Par.        | 23,516          | 19,846          | -3,670                  | -16                       | 12.2                                   | 15.8                                   | 5.6   | 30                         | 0                                     |
| De Soto Par.          | 26,359          | 27,267          | 908                     | 3                         | 15.2                                   | 28.2                                   | 20.3  | 86                         | 5                                     |
| East Baton Rouge Par. | 382,572         | 444,511         | 61,939                  | 16                        | 84.7                                   | 121.6                                  | 57.7  | 44                         | 41                                    |
| East Carroll Par.     | 11,342          | 7,111           | -4,231                  | -37                       | 5.3                                    | 7.0                                    | 2.7   | 32                         | 0                                     |
| East Feliciana Par.   | 19,453          | 19,380          | -73                     | 0                         | 9.2                                    | 14.7                                   | 8.6   | 60                         | 0                                     |
| Evangeline Par.       | 34,147          | 33,663          | -484                    | -1                        | 10.9                                   | 15.3                                   | 6.9   | 40                         | 0                                     |
| Franklin Par.         | 24,295          | 20,256          | -4,039                  | -17                       | 7.5                                    | 10.5                                   | 4.7   | 40                         | 0                                     |
| Grant Par.            | 17,206          | 22,296          | 5,090                   | 30                        | 8.7                                    | 14.3                                   | 8.8   | 64                         | 52                                    |
| Iberia Par.           | 68,801          | 71,982          | 3,181                   | 5                         | 20.1                                   | 32.9                                   | 20.0  | 64                         | 9                                     |

| Louisiana Parish     | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Iberville Par.       | 32,840          | 32,906          | 66                      | 0                         | 15.6                                   | 24.7                                   | 14.2  | 58                         | 0                                     |
| Jackson Par.         | 17,011          | 15,898          | -1,113                  | -7                        | 9.7                                    | 16.8                                   | 11.1  | 73                         | 0                                     |
| Jefferson Par.       | 467,248         | 436,126         | -31,122                 | -7                        | 54.5                                   | 63.7                                   | 14.4  | 17                         | 0                                     |
| Jefferson Davis Par. | 32,700          | 31,480          | -1,220                  | -4                        | 11.0                                   | 16.2                                   | 8.1   | 47                         | 0                                     |
| Lafayette Par.       | 164,025         | 241,756         | 77,731                  | 47                        | 35.3                                   | 66.7                                   | 49.1  | 89                         | 61                                    |
| Lafourche Par.       | 87,886          | 98,123          | 10,237                  | 12                        | 16.5                                   | 40.8                                   | 38.0  | 147                        | 12                                    |
| La Salle Par.        | 16,810          | 14,887          | -1,923                  | -11                       | 7.6                                    | 15.3                                   | 12.0  | 101                        | 0                                     |
| Lincoln Par.         | 40,433          | 47,471          | 7,038                   | 17                        | 17.5                                   | 34.5                                   | 26.6  | 97                         | 24                                    |
| Livingston Par.      | 63,664          | 137,712         | 74,048                  | 116                       | 19.9                                   | 59.9                                   | 62.5  | 201                        | 70                                    |
| Madison Par.         | 15,257          | 11,342          | -3,915                  | -26                       | 7.5                                    | 10.3                                   | 4.4   | 37                         | 0                                     |
| Morehouse Par.       | 34,448          | 25,655          | -8,793                  | -26                       | 19.9                                   | 26.1                                   | 9.7   | 31                         | 0                                     |
| Natchitoches Par.    | 39,908          | 39,042          | -866                    | -2                        | 17.0                                   | 27.0                                   | 15.6  | 59                         | 0                                     |

| Louisiana Parish   | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Orleans Par.       | 561,596         | 391,493         | -170,103                | -30                       | 43.2                                   | 52.0                                   | 13.8  | 20                         | 0                                     |
| Ouachita Par.      | 141,490         | 155,841         | 14,351                  | 10                        | 47.1                                   | 74.1                                   | 42.2  | 57                         | 21                                    |
| Plaquemines Par.   | 26,752          | 23,348          | -3,404                  | -13                       | 11.8                                   | 15.2                                   | 5.3   | 29                         | 0                                     |
| Pointe Coupee Par. | 24,594          | 22,164          | -2,430                  | -10                       | 13.8                                   | 17.3                                   | 5.5   | 25                         | 0                                     |
| Rapides Par.       | 135,671         | 131,253         | -4,418                  | -3                        | 39.8                                   | 62.4                                   | 35.3  | 57                         | 0                                     |
| Red River Par.     | 10,798          | 8,527           | -2,271                  | -21                       | 7.0                                    | 9.3                                    | 3.6   | 33                         | 0                                     |
| Richland Par.      | 22,345          | 20,413          | -1,932                  | -9                        | 9.0                                    | 15.3                                   | 9.8   | 70                         | 0                                     |
| Sabine Par.        | 25,677          | 23,909          | -1,768                  | -7                        | 11.0                                   | 21.1                                   | 15.8  | 92                         | 0                                     |
| St. Bernard Par.   | 66,424          | 46,110          | -20,314                 | -31                       | 7.6                                    | 11.5                                   | 6.1   | 51                         | 0                                     |
| St. Charles Par.   | 39,596          | 52,620          | 13,024                  | 33                        | 10.1                                   | 17.1                                   | 10.9  | 69                         | 54                                    |
| St. Helena Par.    | 9,856           | 10,322          | 466                     | 5                         | 5.4                                    | 8.3                                    | 4.5   | 54                         | 11                                    |
| St. James Par.     | 21,830          | 21,380          | -450                    | -2                        | 11.5                                   | 13.9                                   | 3.8   | 21                         | 0                                     |

| Louisiana Parish          | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| St. John the Baptist Par. | 35,809          | 43,328          | 7,519                   | 21                        | 9.2                                    | 14.8                                   | 8.8   | 61                         | 0                                     |
| St. Landry Par.           | 87,253          | 83,535          | -3,718                  | -4                        | 19.0                                   | 41.1                                   | 34.5  | 116                        | 0                                     |
| St. Martin Par.           | 43,343          | 54,066          | 10,723                  | 25                        | 12.3                                   | 24.0                                   | 18.3  | 95                         | 33                                    |
| St. Mary Par.             | 66,176          | 50,708          | -15,468                 | -23                       | 20.9                                   | 26.9                                   | 9.4   | 29                         | 0                                     |
| St. Tammany Par.          | 121,684         | 255,921         | 134,237                 | 110                       | 65.3                                   | 113.6                                  | 75.5  | 74                         | 100                                   |
| Tangipahoa Par.           | 84,663          | 132,353         | 47,690                  | 56                        | 32.2                                   | 61.6                                   | 45.9  | 91                         | 69                                    |
| Tensas Par.               | 8,191           | 4,574           | -3,617                  | -44                       | 6.6                                    | 6.6                                    | 0.0   | 0                          | 0                                     |
| Terrebonne Par.           | 100,485         | 111,823         | 11,338                  | 11                        | 26.4                                   | 44.4                                   | 28.1  | 68                         | 21                                    |
| Union Par.                | 21,343          | 22,398          | 1,055                   | 5                         | 16.8                                   | 25.3                                   | 13.3  | 51                         | 12                                    |
| Vermilion Par.            | 50,984          | 59,936          | 8,952                   | 18                        | 12.5                                   | 33.2                                   | 32.3  | 166                        | 17                                    |
| Vernon Par.               | 59,654          | 49,789          | -9,865                  | -17                       | 19.0                                   | 40.4                                   | 33.4  | 113                        | 0                                     |

| <b>Louisiana Parish</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Washington Par.         | 44,443                 | 46,649                 | 2,206                          | 5                                | 13.7  | 25.7  | 18.8   | 88                                | 8  |
| Webster Par.            | 44,112                 | 39,264                 | -4,848                         | -11                              | 16.7  | 27.3  | 16.6   | 63                                | 0  |
| West Baton Rouge Par.   | 19,550                 | 26,184                 | 6,634                          | 34                               | 13.4  | 19.8  | 10.0   | 48                                | 75   |
| West Carroll Par.       | 12,874                 | 10,974                 | -1,900                         | -15                              | 7.2   | 9.1   | 3.0  | 26                                | 0  |
| West Feliciana Par.     | 12,801                 | 15,371                 | 2,570                          | 20                               | 6.3   | 7.9   | 2.5  | 25                                | 81   |
| Winn Par.               | 17,522                 | 14,350                 | -3,172                         | -18                              | 12.0  | 19.1  | 11.1   | 59                                | 0  |
| <b>Totals</b>           | <b>4,352,609</b>       | <b>4,670,560</b>       | <b>317,951</b>                 | <b>7</b>                         | <b>1,235.5</b>                                | <b>1,998.1</b>                                | <b>1,191.6</b>   | <b>62</b>                         | <b>15</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>31</b>                                    |



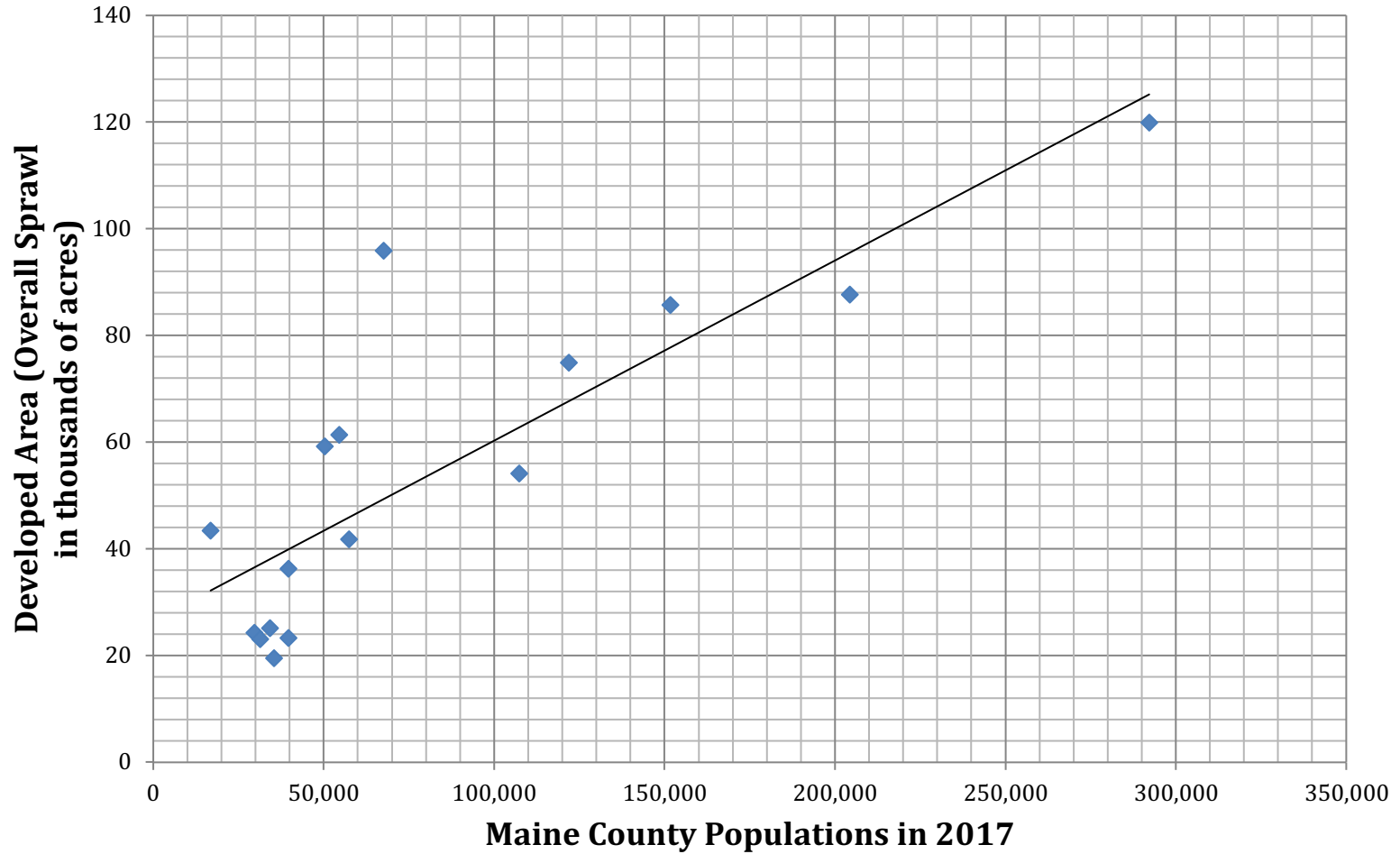
**Scatter Plot for Louisiana Parish Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.8**

**Maine**

| Maine County     | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Androscoggin Co. | 98,860          | 107,399         | 8,539                   | 9                         | 34.4                                   | 54.1                                   | 30.8  | 57                         | 18                                    |
| Aroostook Co.    | 90,171          | 67,609          | -22,562                 | -25                       | 75.5                                   | 95.9                                   | 31.9  | 27                         | 0                                     |
| Cumberland Co.   | 220,441         | 292,181         | 71,740                  | 33                        | 52.5                                   | 119.9                                  | 105.3   | 128                        | 34                                    |
| Franklin Co.     | 27,885          | 29,799          | 1,914                   | 7                         | 13.8                                   | 24.2                                   | 16.3  | 75                         | 12                                    |
| Hancock Co.      | 42,308          | 54,539          | 12,231                  | 29                        | 37.6                                   | 61.3                                   | 37.0  | 63                         | 52                                    |
| Kennebec Co.     | 110,343         | 121,913         | 11,570                  | 10                        | 41.8                                   | 74.9                                   | 51.7  | 79                         | 17                                    |
| Knox Co.         | 33,414          | 39,759          | 6,345                   | 19                        | 12.2                                   | 23.3                                   | 17.3  | 91                         | 27                                    |
| Lincoln Co.      | 26,090          | 34,215          | 8,125                   | 31                        | 15.6                                   | 25.1                                   | 14.8  | 61                         | 57                                    |
| Oxford Co.       | 49,018          | 57,534          | 8,516                   | 17                        | 24.2                                   | 41.8                                   | 27.5  | 73                         | 29                                    |
| Penobscot Co.    | 138,020         | 151,645         | 13,625                  | 10                        | 44.7                                   | 85.7                                   | 64.1  | 92                         | 14                                    |
| Piscataquis Co.  | 17,657          | 16,804          | -853                    | -5                        | 28.6                                   | 43.4                                   | 23.1  | 52                         | 0                                     |

| Maine County            | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Sagadahoc Co.           | 29,488           | 35,436           | 5,948                   | 20                        | 9.0                                    | 19.5                                   | 16.4  | 117                        | 24                                    |
| Somerset Co.            | 45,468           | 50,351           | 4,883                   | 11                        | 40.1                                   | 59.2                                   | 29.8  | 48                         | 26                                    |
| Waldo Co.               | 28,708           | 39,772           | 11,064                  | 39                        | 21.1                                   | 36.3                                   | 23.8  | 72                         | 60                                    |
| Washington Co.          | 34,346           | 31,374           | -2,972                  | -9                        | 18.1                                   | 23.1                                   | 7.8   | 28                         | 0                                     |
| York Co.                | 144,466          | 204,282          | 59,816                  | 41                        | 34.2                                   | 87.6                                   | 83.4  | 156                        | 37                                    |
| <b>Totals</b>           | <b>1,136,683</b> | <b>1,334,612</b> | <b>197,929</b>          | <b>17</b>                 | <b>503.4</b>                           | <b>875.3</b>                           | <b>581.1</b>                                      | <b>74</b>                  | <b>29</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>27</b>                             |



**Scatter Plot for Maine County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

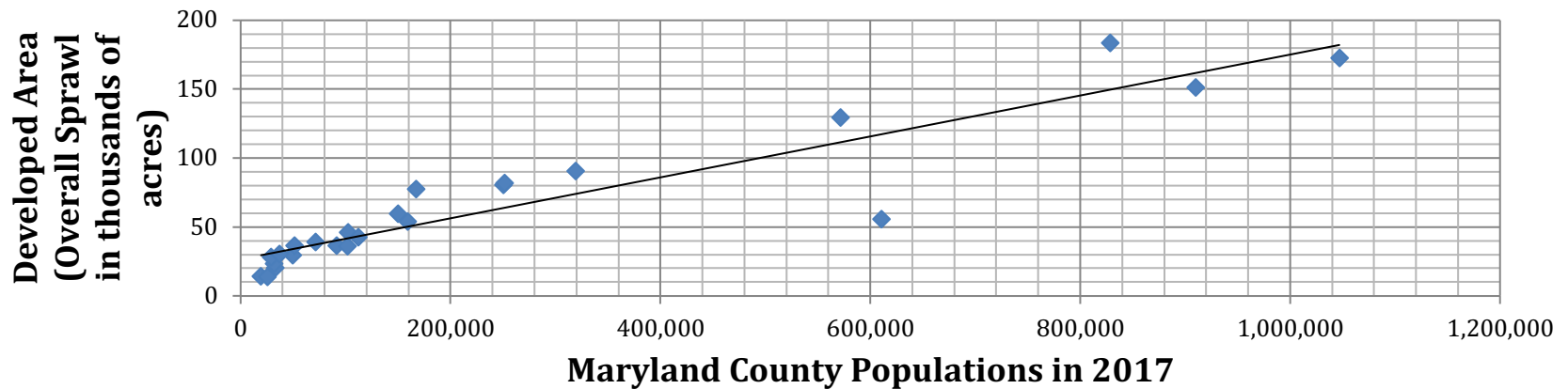
**R-value: 0.84**

**Maryland**

| <b>Maryland County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Allegany Co.           | 79,651                 | 71,352                 | -8,299                         | -10                              | 30.1  | 39.2  | 14.2   | 30                                | 0  |
| Anne Arundel Co.       | 382,453                | 571,339                | 188,886                        | 49                               | 90.2  | 129.5   | 61.4   | 44                                | 100  |
| Baltimore Co.          | 658,403                | 828,645                | 170,242                        | 26                               | 135.0   | 183.7   | 76.1   | 36                                | 75   |
| Calvert Co.            | 36,225                 | 91,435                 | 55,210                         | 152                              | 11.6  | 36.5  | 38.9   | 215                               | 81   |
| Caroline Co.           | 23,615                 | 33,096                 | 9,481                          | 40                               | 13.2  | 20.3  | 11.1   | 54                                | 78   |
| Carroll Co.            | 100,024                | 167,547                | 67,523                         | 68                               | 39.5  | 77.4  | 59.2   | 96                                | 77   |
| Cecil Co.              | 62,067                 | 102,394                | 40,327                         | 65                               | 21.6  | 46.3  | 38.6   | 114                               | 66   |
| Charles Co.            | 77,897                 | 159,450                | 81,553                         | 105                              | 31.7  | 53.9  | 34.7   | 70                                | 100  |
| Dorchester Co.         | 30,194                 | 32,105                 | 1,911                          | 6                                | 16.8  | 23.7  | 10.8   | 41                                | 18   |
| Frederick Co.          | 121,088                | 250,622                | 129,534                        | 107                              | 39.0  | 80.7  | 65.2   | 107                               | 100  |
| Garrett Co.            | 26,937                 | 29,242                 | 2,305                          | 9                                | 17.0  | 28.3  | 17.7   | 66                                | 16   |

| <b>Maryland County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Harford Co.            | 149,551                | 251,858                | 102,307                        | 68                               | 53.4  | 81.8  | 44.4   | 53                                | 100  |
| Howard Co.             | 127,942                | 319,251                | 191,309                        | 150                              | 54.1  | 90.6  | 57.0   | 67                                | 100  |
| Kent Co.               | 16,672                 | 19,442                 | 2,770                          | 17                               | 9.7   | 14.4  | 7.3  | 48                                | 39   |
| Montgomery Co.         | 600,479                | 1,046,822              | 446,343                        | 74                               | 121.6   | 172.8   | 80.0   | 42                                | 100  |
| Prince George's Co.    | 671,811                | 909,705                | 237,894                        | 35                               | 99.5  | 151.5   | 81.3   | 52                                | 72   |
| Queen Anne's Co.       | 26,583                 | 49,586                 | 23,003                         | 87                               | 17.8  | 29.7  | 18.6   | 67                                | 100  |
| St. Mary's Co.         | 61,697                 | 112,487                | 50,790                         | 82                               | 17.5  | 42.5  | 39.1   | 143                               | 68   |
| Somerset Co.           | 18,874                 | 25,896                 | 7,022                          | 37                               | 9.1   | 13.9  | 7.5  | 53                                | 75   |
| Talbot Co.             | 26,561                 | 37,033                 | 10,472                         | 39                               | 16.4  | 30.6  | 22.2   | 87                                | 53   |
| Washington Co.         | 112,244                | 150,169                | 37,925                         | 34                               | 33.4  | 59.5  | 40.8   | 78                                | 50   |
| Wicomico Co.           | 65,414                 | 102,252                | 36,838                         | 56                               | 21.8  | 36.0  | 22.2   | 65                                | 89   |
| Worcester Co.          | 30,749                 | 51,659                 | 20,910                         | 68                               | 17.9  | 36.4  | 28.9   | 103                               | 73   |

| Maryland County         | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Baltimore City          | 775,792          | 610,481          | -165,311                | -21                       | 55.8                                   | 55.8                                   | 0.0   | 0                          | 0                                     |
| <b>Totals</b>           | <b>4,282,923</b> | <b>6,023,868</b> | <b>1,740,945</b>        | <b>41</b>                 | <b>973.7</b>                           | <b>1,535.0</b>                         | <b>877.0</b>                                      | <b>58</b>                  | <b>75</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>80</b>                             |



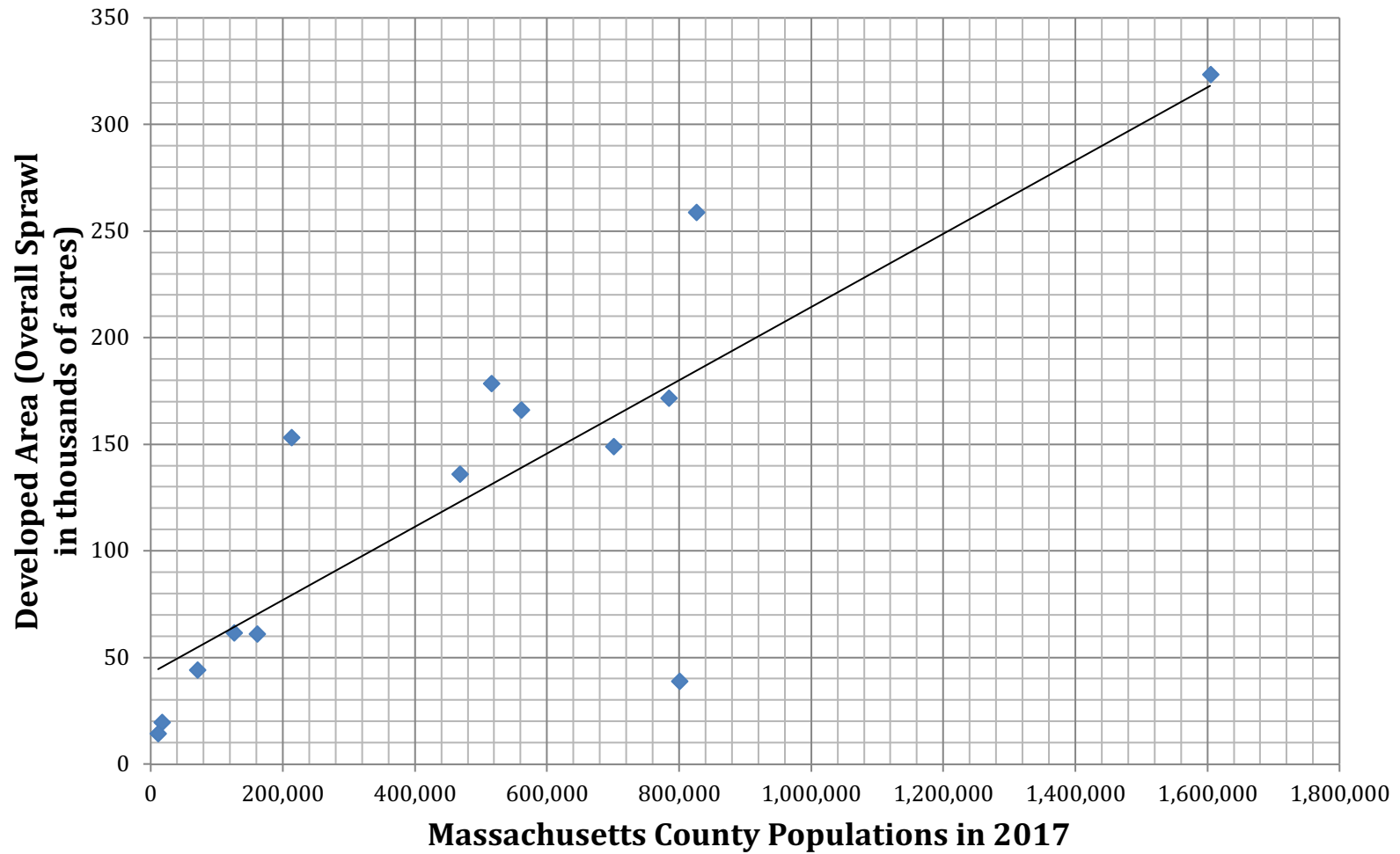
**Scatter Plot for Maryland County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.93**

## Massachusetts

| Massachusetts County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Barnstable Co.       | 154,460         | 213,581         | 59,121                  | 38                        | 101.0                                  | 153.1                                  | 81.4  | 52                         | 78                                    |
| Berkshire Co.        | 142,162         | 126,353         | -15,809                 | -11                       | 40.1                                   | 61.6                                   | 33.6  | 54                         | 0                                     |
| Bristol Co.          | 477,118         | 560,941         | 83,823                  | 18                        | 103.2                                  | 166.2                                  | 98.4  | 61                         | 34                                    |
| Dukes Co.            | 9,552           | 17,311          | 7,759                   | 81                        | 10.3                                   | 19.6                                   | 14.5  | 90                         | 92                                    |
| Essex Co.            | 642,680         | 784,453         | 141,773                 | 22                        | 106.5                                  | 171.7                                  | 101.9   | 61                         | 42                                    |
| Franklin Co.         | 62,980          | 70,605          | 7,625                   | 12                        | 26.1                                   | 44.1                                   | 28.1  | 69                         | 22                                    |
| Hampden Co.          | 440,975         | 467,705         | 26,730                  | 6                         | 92.5                                   | 136.0                                  | 68.0  | 47                         | 15                                    |
| Hampshire Co.        | 139,730         | 161,077         | 21,347                  | 15                        | 38.9                                   | 61.1                                   | 34.7  | 57                         | 31                                    |
| Middlesex Co.        | 1,374,292       | 1,603,943       | 229,651                 | 17                        | 203.1                                  | 323.4                                  | 188.0   | 59                         | 33                                    |
| Nantucket Co.        | 5,271           | 11,205          | 5,934                   | 113                       | 6.7                                    | 14.3                                   | 11.9  | 113                        | 99                                    |
| Norfolk Co.          | 605,637         | 700,599         | 94,962                  | 16                        | 95.9                                   | 148.9                                  | 82.8  | 55                         | 33                                    |

| <b>Massachusetts County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Plymouth Co.                | 409,665                | 515,461                | 105,796                        | 26                               | 101.6   | 178.6   | 120.3  | 76                                | 41   |
| Suffolk Co.                 | 657,941                | 800,806                | 142,865                        | 22                               | 36.4  | 39.0  | 4.1  | 7                                 | 100  |
| Worcester Co.               | 648,759                | 825,749                | 176,990                        | 27                               | 149.8   | 258.9   | 170.5  | 73                                | 44   |
| <b>Totals</b>               | <b>5,771,222</b>       | <b>6,859,789</b>       | <b>1,088,567</b>               | <b>19</b>                        | <b>1,112.1</b>                                | <b>1,776.5</b>                                | <b>1,038.1</b>   | <b>60</b>                         | <b>37</b>                                    |
| <b>Weighted Average</b>     |                        |                        |                                |                                  |   |   |  |                                   | <b>39</b>                                    |



**Scatter Plot for Massachusetts County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.82**

**Michigan**

| <b>Michigan County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Alcona Co.             | 9,802                  | 10,309                 | 507                            | 5                                | 8.8   | 15.1  | 9.8  | 72                                | 9  |
| Alger Co.              | 9,252                  | 9,144                  | -108                           | -1                               | 5.7   | 8.3   | 4.1  | 46                                | 0  |
| Allegan Co.            | 83,214                 | 116,368                | 33,154                         | 40                               | 44.8  | 73.2  | 44.4   | 63                                | 68   |
| Alpena Co.             | 32,122                 | 28,428                 | -3,694                         | -11                              | 12.2  | 16.8  | 7.2  | 38                                | 0  |
| Antrim Co.             | 16,668                 | 23,270                 | 6,602                          | 40                               | 35.6  | 45.2  | 15.0   | 27                                | 100  |
| Arenac Co.             | 14,894                 | 15,014                 | 120                            | 1                                | 11.5  | 19.2  | 12.0   | 67                                | 2  |
| Baraga Co.             | 8,474                  | 8,441                  | -33                            | 0                                | 8.3   | 11.8  | 5.5  | 42                                | 0  |
| Barry Co.              | 46,707                 | 60,682                 | 13,975                         | 30                               | 26.6  | 53.9  | 42.7   | 103                               | 37   |
| Bay Co.                | 118,804                | 104,045                | -14,759                        | -12                              | 33.1  | 42.1  | 14.1   | 27                                | 0  |
| Benzie Co.             | 11,260                 | 17,624                 | 6,364                          | 57                               | 10.0  | 27.7  | 27.7   | 177                               | 44   |
| Berrien Co.            | 166,840                | 154,128                | -12,712                        | -8                               | 54.4  | 79.7  | 39.5   | 47                                | 0  |

| Michigan County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Branch Co.      | 39,585          | 43,375          | 3,790                   | 10                        | 18.9                                   | 23.8                                   | 7.7   | 26                         | 40                                    |
| Calhoun Co.     | 139,886         | 134,180         | -5,706                  | -4                        | 51.4                                   | 65.1                                   | 21.4  | 27                         | 0                                     |
| Cass Co.        | 48,994          | 51,481          | 2,487                   | 5                         | 23.1                                   | 31.6                                   | 13.3  | 37                         | 16                                    |
| Charlevoix Co.  | 19,918          | 26,212          | 6,294                   | 32                        | 17.2                                   | 23.9                                   | 10.5  | 39                         | 83                                    |
| Cheboygan Co.   | 20,961          | 25,454          | 4,493                   | 21                        | 6.4                                    | 13.6                                   | 11.3  | 113                        | 26                                    |
| Chippewa Co.    | 29,748          | 37,679          | 7,931                   | 27                        | 13.4                                   | 24.1                                   | 16.7  | 80                         | 40                                    |
| Clare Co.       | 23,937          | 30,565          | 6,628                   | 28                        | 17.6                                   | 29.5                                   | 18.6  | 68                         | 47                                    |
| Clinton Co.     | 55,796          | 78,506          | 22,710                  | 41                        | 24.0                                   | 33.9                                   | 15.5  | 41                         | 99                                    |
| Crawford Co.    | 9,911           | 13,906          | 3,995                   | 40                        | 20.1                                   | 36.0                                   | 24.8  | 79                         | 58                                    |
| Delta Co.       | 39,826          | 35,890          | -3,936                  | -10                       | 22.2                                   | 30.3                                   | 12.7  | 36                         | 0                                     |
| Dickinson Co.   | 25,799          | 25,424          | -375                    | -1                        | 18.8                                   | 23.6                                   | 7.5   | 26                         | 0                                     |
| Eaton Co.       | 88,391          | 109,456         | 21,065                  | 24                        | 34.4                                   | 57.9                                   | 36.7  | 68                         | 41                                    |

| <b>Michigan County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Emmet Co.              | 23,374                 | 33,081                 | 9,707                          | 42                               | 24.2  | 43.6  | 30.3   | 80                                | 59   |
| Genesee Co.            | 437,115                | 407,488                | -29,627                        | -7                               | 129.0   | 169.7   | 63.6   | 32                                | 0  |
| Gladwin Co.            | 20,291                 | 25,241                 | 4,950                          | 24                               | 18.0  | 29.6  | 18.1   | 64                                | 44   |
| Gogebic Co.            | 20,012                 | 15,340                 | -4,672                         | -23                              | 13.1  | 16.5  | 5.3  | 26                                | 0  |
| Grand Traverse Co.     | 56,922                 | 91,791                 | 34,869                         | 61                               | 27.3  | 49.5  | 34.7   | 81                                | 80   |
| Gratiot Co.            | 39,818                 | 40,979                 | 1,161                          | 3                                | 16.8  | 23.6  | 10.6   | 40                                | 8  |
| Hillsdale Co.          | 41,810                 | 45,820                 | 4,010                          | 10                               | 26.9  | 37.7  | 16.9   | 40                                | 27   |
| Houghton Co.           | 38,134                 | 36,198                 | -1,936                         | -5                               | 21.3  | 28.4  | 11.1   | 33                                | 0  |
| Huron Co.              | 36,422                 | 31,306                 | -5,116                         | -14                              | 21.9  | 26.7  | 7.5  | 22                                | 0  |
| Ingham Co.             | 270,719                | 292,018                | 21,299                         | 8                                | 48.3  | 85.6  | 58.3   | 77                                | 13   |
| Ionia Co.              | 52,362                 | 64,284                 | 11,922                         | 23                               | 17.7  | 30.5  | 20.0   | 72                                | 38   |

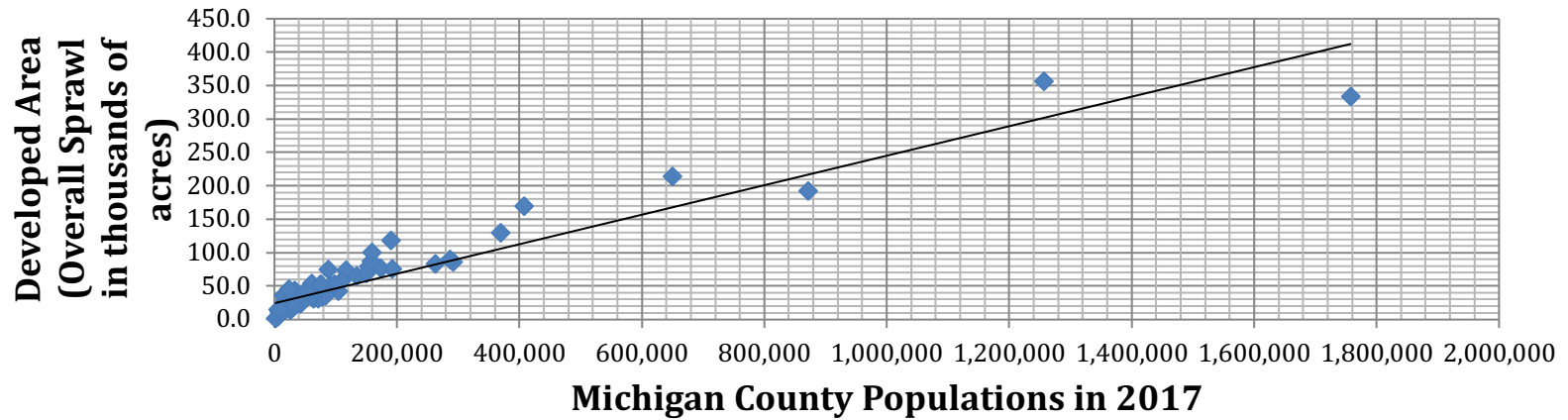
| <b>Michigan County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Iosco Co.              | 29,308                 | 25,128                 | -4,180                         | -14                              | 16.3  | 27.1  | 16.9   | 66                                | 0  |
| Iron Co.               | 13,678                 | 11,105                 | -2,573                         | -19                              | 8.8   | 14.1  | 8.3  | 60                                | 0  |
| Isabella Co.           | 54,031                 | 71,077                 | 17,046                         | 32                               | 17.6  | 30.5  | 20.2   | 73                                | 50   |
| Jackson Co.            | 150,195                | 158,563                | 8,368                          | 6                                | 60.1  | 86.6  | 41.4   | 44                                | 15   |
| Kalamazoo Co.          | 213,434                | 262,998                | 49,564                         | 23                               | 56.8  | 83.0  | 40.9   | 46                                | 55   |
| Kalkaska Co.           | 11,503                 | 17,571                 | 6,068                          | 53                               | 12.3  | 22.5  | 15.9   | 83                                | 70   |
| Kent Co.               | 449,249                | 649,278                | 200,029                        | 45                               | 137.7   | 214.1   | 119.4  | 55                                | 83   |
| Keweenaw Co.           | 2,015                  | 2,085                  | 70                             | 3                                | 1.9   | 1.9   | 0.0  | 0                                 | 0  |
| Lake Co.               | 8,116                  | 11,981                 | 3,865                          | 48                               | 11.3  | 18.0  | 10.5   | 59                                | 84   |
| Lapeer Co.             | 69,783                 | 88,122                 | 18,339                         | 26                               | 48.3  | 75.0  | 41.7   | 55                                | 53   |
| Leelanau Co.           | 14,645                 | 21,645                 | 7,000                          | 48                               | 8.7   | 20.4  | 18.3   | 134                               | 46   |
| Lenawee Co.            | 89,163                 | 98,427                 | 9,264                          | 10                               | 32.9  | 52.3  | 30.3   | 59                                | 21   |

| <b>Michigan County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Livingston Co.         | 100,697                | 189,869                | 89,172                         | 89                               | 57.2  | 117.7   | 94.5   | 106                               | 88   |
| Luce Co.               | 6,229                  | 6,370                  | 141                            | 2                                | 12.6  | 14.4  | 2.8  | 14                                | 17   |
| Mackinac Co.           | 10,308                 | 10,768                 | 460                            | 4                                | 11.7  | 18.3  | 10.3   | 56                                | 10   |
| Macomb Co.             | 684,852                | 871,364                | 186,512                        | 27                               | 121.1   | 191.8   | 110.5  | 58                                | 52   |
| Manistee Co.           | 22,521                 | 24,393                 | 1,872                          | 8                                | 16.8  | 27.0  | 15.9   | 61                                | 17   |
| Marquette Co.          | 73,719                 | 66,493                 | -7,226                         | -10                              | 28.5  | 40.0  | 18.0   | 40                                | 0  |
| Mason Co.              | 26,507                 | 28,996                 | 2,489                          | 9                                | 11.8  | 21.2  | 14.7   | 80                                | 15   |
| Mecosta Co.            | 36,723                 | 43,258                 | 6,535                          | 18                               | 7.4   | 29.6  | 34.7   | 300                               | 12   |
| Menominee Co.          | 26,291                 | 22,981                 | -3,310                         | -13                              | 20.2  | 22.2  | 3.1  | 10                                | 0  |
| Midland Co.            | 74,784                 | 83,314                 | 8,530                          | 11                               | 21.5  | 35.6  | 22.0   | 66                                | 21   |
| Missaukee Co.          | 10,508                 | 15,020                 | 4,512                          | 43                               | 7.8   | 14.3  | 10.2   | 83                                | 59   |
| Monroe Co.             | 132,334                | 149,449                | 17,115                         | 13                               | 50.0  | 68.7  | 29.2   | 37                                | 38   |

| Michigan County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Montcalm Co.    | 48,771          | 63,527          | 14,756                  | 30                        | 24.2                                   | 34.1                                   | 15.5  | 41                         | 77                                    |
| Montmorency Co. | 7,532           | 9,233           | 1,701                   | 23                        | 8.5                                    | 13.0                                   | 7.0   | 53                         | 48                                    |
| Muskegon Co.    | 156,114         | 173,645         | 17,531                  | 11                        | 50.8                                   | 76.1                                   | 39.5  | 50                         | 26                                    |
| Newaygo Co.     | 35,647          | 48,320          | 12,673                  | 36                        | 18.5                                   | 37.4                                   | 29.5  | 102                        | 43                                    |
| Oakland Co.     | 997,169         | 1,256,016       | 258,847                 | 26                        | 242.2                                  | 355.9                                  | 177.7   | 47                         | 60                                    |
| Oceana Co.      | 21,879          | 26,422          | 4,543                   | 21                        | 11.5                                   | 18.4                                   | 10.8  | 60                         | 40                                    |
| Ogemaw Co.      | 16,853          | 20,882          | 4,029                   | 24                        | 16.8                                   | 22.6                                   | 9.1   | 35                         | 72                                    |
| Ontonagon Co.   | 10,315          | 5,889           | -4,426                  | -43                       | 4.2                                    | 4.6                                    | 0.6   | 10                         | 0                                     |
| Osceola Co.     | 19,512          | 23,267          | 3,755                   | 19                        | 19.0                                   | 29.3                                   | 16.1  | 54                         | 41                                    |
| Oscoda Co.      | 7,140           | 8,238           | 1,098                   | 15                        | 4.8                                    | 11.0                                   | 9.7   | 129                        | 17                                    |
| Otsego Co.      | 15,434          | 24,528          | 9,094                   | 59                        | 14.3                                   | 28.9                                   | 22.8  | 102                        | 66                                    |
| Ottawa Co.      | 161,627         | 286,581         | 124,954                 | 77                        | 44.6                                   | 89.4                                   | 70.0  | 100                        | 82                                    |

| <b>Michigan County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Presque Isle Co.       | 14,050                 | 12,742                 | -1,308                         | -9                               | 12.8  | 19.0  | 9.7  | 48                                | 0  |
| Roscommon Co.          | 17,242                 | 23,731                 | 6,489                          | 38                               | 30.3  | 44.1  | 21.6   | 46                                | 85   |
| Saginaw Co.            | 220,925                | 191,965                | -28,960                        | -13                              | 49.6  | 75.7  | 40.8   | 53                                | 0  |
| St. Clair Co.          | 138,598                | 159,005                | 20,407                         | 15                               | 64.1  | 100.2   | 56.4   | 56                                | 31   |
| St. Joseph Co.         | 57,492                 | 60,710                 | 3,218                          | 6                                | 30.4  | 35.7  | 8.3  | 17                                | 34   |
| Sanilac Co.            | 40,299                 | 41,242                 | 943                            | 2                                | 17.3  | 25.1  | 12.2   | 45                                | 6  |
| Schoolcraft Co.        | 8,627                  | 8,013                  | -614                           | -7                               | 13.0  | 14.7  | 2.7  | 13                                | 0  |
| Shiawassee Co.         | 70,317                 | 68,400                 | -1,917                         | -3                               | 28.9  | 43.4  | 22.7   | 50                                | 0  |
| Tuscola Co.            | 56,167                 | 52,815                 | -3,352                         | -6                               | 33.2  | 41.7  | 13.3   | 26                                | 0  |
| Van Buren Co.          | 67,228                 | 75,303                 | 8,075                          | 12                               | 37.7  | 53.1  | 24.1   | 41                                | 33   |
| Washtenaw Co.          | 260,239                | 368,807                | 108,568                        | 42                               | 87.2  | 129.4   | 65.9   | 48                                | 88   |
| Wayne Co.              | 2,231,999              | 1,757,217              | -474,782                       | -21                              | 279.2   | 333.4   | 84.7   | 19                                | 0  |

| Michigan County         | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Wexford Co.             | 25,659           | 33,234           | 7,575                   | 30                        | 12.1                                   | 20.5                                   | 13.1  | 69                         | 49                                    |
| <b>Totals</b>           | <b>9,115,196</b> | <b>9,973,114</b> | <b>857,918</b>          | <b>9</b>                  | <b>2,817.5</b>                         | <b>4,230.7</b>                         | <b>2,208.1</b>                                    | <b>50</b>                  | <b>22</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>43</b>                             |



**Scatter Plot for Michigan County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.95**

**Minnesota**

| <b>Minnesota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Aitkin Co.              | 13,248                 | 15,792                 | 2,544                          | 19                               | 16.7  | 21.0  | 6.7  | 26                                | 77   |
| Anoka Co.               | 203,185                | 350,203                | 147,018                        | 72                               | 58.3  | 115.0   | 88.6   | 97                                | 80   |
| Becker Co.              | 29,118                 | 34,082                 | 4,964                          | 17                               | 31.1  | 37.7  | 10.3   | 21                                | 82   |
| Beltrami Co.            | 32,803                 | 46,477                 | 13,674                         | 42                               | 18.5  | 28.8  | 16.1   | 56                                | 79   |
| Benton Co.              | 25,983                 | 40,135                 | 14,152                         | 54                               | 10.6  | 18.6  | 12.5   | 75                                | 77   |
| Big Stone Co.           | 7,661                  | 5,004                  | -2,657                         | -35                              | 8.1   | 11.6  | 5.5  | 43                                | 0  |
| Blue Earth Co.          | 52,755                 | 66,916                 | 14,161                         | 27                               | 30.0  | 38.4  | 13.1   | 28                                | 96   |
| Brown Co.               | 28,645                 | 25,172                 | -3,473                         | -12                              | 13.1  | 14.5  | 2.2  | 11                                | 0  |
| Carlton Co.             | 29,796                 | 35,509                 | 5,713                          | 19                               | 20.5  | 28.5  | 12.5   | 39                                | 53   |
| Carver Co.              | 38,516                 | 102,118                | 63,602                         | 165                              | 15.8  | 37.2  | 33.4   | 135                               | 100  |
| Cass Co.                | 21,040                 | 29,324                 | 8,284                          | 39                               | 32.7  | 45.1  | 19.4   | 38                                | 100  |

| <b>Minnesota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Chippewa Co.            | 14,684                 | 11,944                 | -2,740                         | -19                              | 9.8   | 15.2  | 8.4  | 55                                | 0  |
| Chisago Co.             | 26,495                 | 55,257                 | 28,762                         | 109                              | 17.3  | 36.2  | 29.5   | 109                               | 100  |
| Clay Co.                | 49,158                 | 63,766                 | 14,608                         | 30                               | 23.3  | 25.3  | 3.1  | 9                                 | 100  |
| Clearwater Co.          | 8,709                  | 8,845                  | 136                            | 2                                | 8.3   | 9.3   | 1.6  | 12                                | 14   |
| Cook Co.                | 4,104                  | 5,411                  | 1,307                          | 32                               | 5.4   | 7.5   | 3.3  | 39                                | 84   |
| Cottonwood Co.          | 14,484                 | 11,249                 | -3,235                         | -22                              | 12.2  | 13.2  | 1.6  | 8                                 | 0  |
| Crow Wing Co.           | 41,723                 | 64,278                 | 22,555                         | 54                               | 33.9  | 51.8  | 28.0   | 53                                | 100  |
| Dakota Co.              | 204,814                | 421,518                | 216,704                        | 106                              | 53.7  | 117.1   | 99.1   | 118                               | 93   |
| Dodge Co.               | 15,052                 | 20,696                 | 5,644                          | 37                               | 9.7   | 11.7  | 3.1  | 21                                | 100  |
| Douglas Co.             | 28,130                 | 37,520                 | 9,390                          | 33                               | 15.2  | 19.1  | 6.1  | 26                                | 100  |
| Faribault Co.           | 19,302                 | 13,768                 | -5,534                         | -29                              | 12.9  | 14.4  | 2.3  | 12                                | 0  |
| Fillmore Co.            | 21,800                 | 20,980                 | -820                           | -4                               | 12.1  | 13.7  | 2.5  | 13                                | 0  |

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|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Freeborn Co.            | 35,555                 | 30,582                 | -4,973                         | -14                              | 20.2  | 24.3  | 6.4  | 20                                | 0  |
| Goodhue Co.             | 39,177                 | 46,307                 | 7,130                          | 18                               | 17.3  | 19.3  | 3.1  | 12                                | 100  |
| Grant Co.               | 7,084                  | 5,916                  | -1,168                         | -16                              | 12.5  | 14.8  | 3.6  | 18                                | 0  |
| Hennepin Co.            | 961,435                | 1,247,847              | 286,412                        | 30                               | 169.8   | 241.8   | 112.5  | 42                                | 74   |
| Houston Co.             | 18,383                 | 18,677                 | 294                            | 2                                | 9.3   | 12.9  | 5.6  | 39                                | 5  |
| Hubbard Co.             | 14,199                 | 20,965                 | 6,766                          | 48                               | 24.2  | 33.8  | 15.0   | 40                                | 100  |
| Isanti Co.              | 23,977                 | 39,543                 | 15,566                         | 65                               | 7.3   | 16.3  | 14.1   | 123                               | 62   |
| Itasca Co.              | 42,890                 | 45,088                 | 2,198                          | 5                                | 24.4  | 32.6  | 12.8   | 34                                | 17   |
| Jackson Co.             | 13,485                 | 9,965                  | -3,520                         | -26                              | 12.5  | 15.9  | 5.3  | 27                                | 0  |
| Kanabec Co.             | 12,443                 | 16,060                 | 3,617                          | 29                               | 7.1   | 10.1  | 4.7  | 42                                | 72   |
| Kandiyohi Co.           | 37,649                 | 42,778                 | 5,129                          | 14                               | 20.9  | 25.5  | 7.2  | 22                                | 64   |
| Kittson Co.             | 6,669                  | 4,261                  | -2,408                         | -36                              | 11.3  | 12.4  | 1.7  | 10                                | 0  |

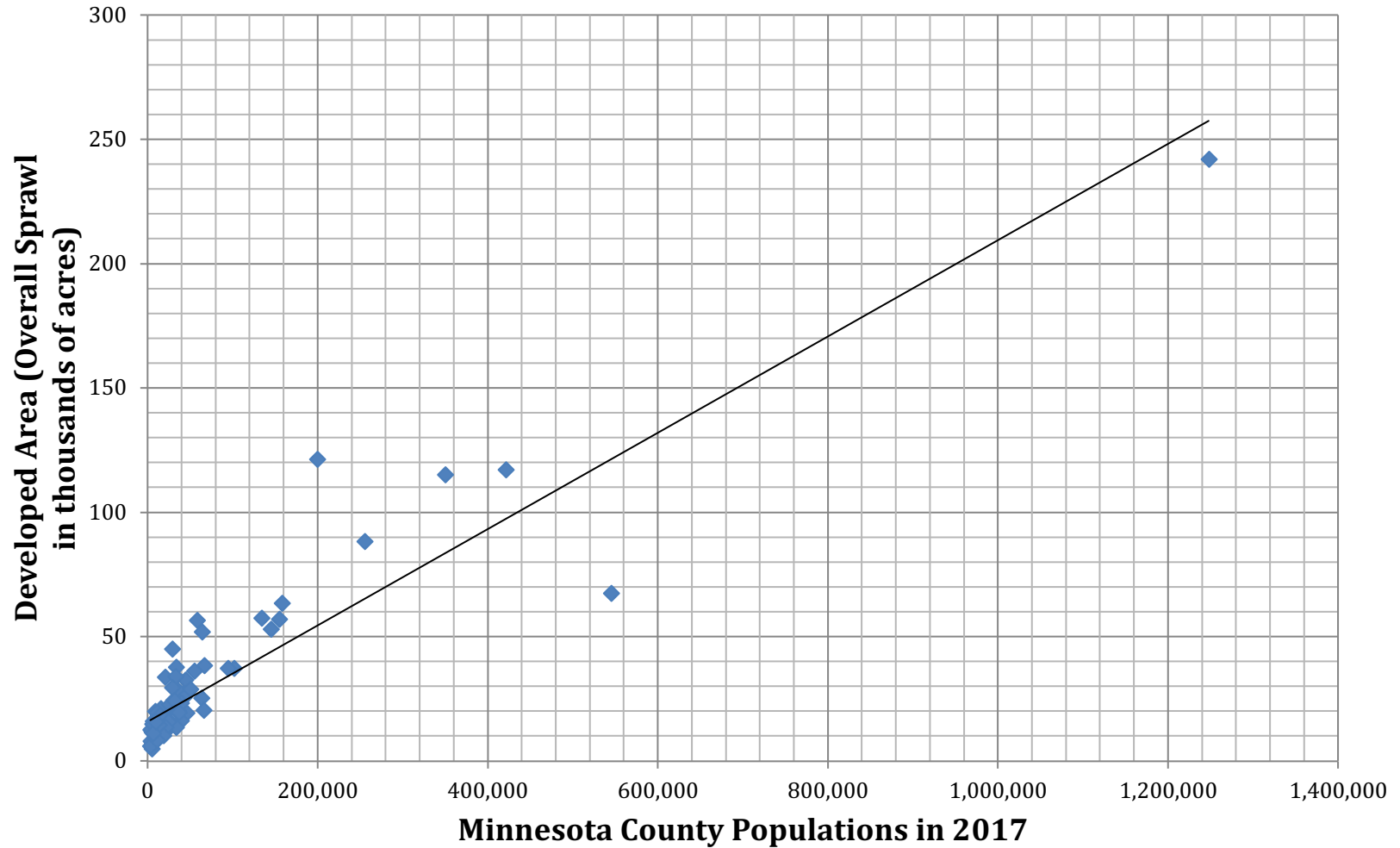
| <b>Minnesota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Koochiching Co.         | 17,224                 | 12,506                 | -4,718                         | -27                              | 18.1  | 18.4  | 0.5  | 2                                 | 0  |
| Lac qui Parle Co.       | 10,369                 | 6,683                  | -3,686                         | -36                              | 13.4  | 16.0  | 4.1  | 19                                | 0  |
| Lake Co.                | 12,480                 | 10,493                 | -1,987                         | -16                              | 7.4   | 8.8   | 2.2  | 19                                | 0  |
| Lake of the Woods Co.   | 3,720                  | 3,727                  | 7                              | 0                                | 8.3   | 12.7  | 6.9  | 53                                | 0  |
| Le Sueur Co.            | 23,371                 | 28,210                 | 4,839                          | 21                               | 13.9  | 21.7  | 12.2   | 56                                | 42   |
| Lincoln Co.             | 7,995                  | 5,665                  | -2,330                         | -29                              | 6.3   | 7.3   | 1.6  | 16                                | 0  |
| Lyon Co.                | 25,440                 | 25,929                 | 489                            | 2                                | 13.4  | 16.0  | 4.1  | 19                                | 11   |
| McLeod Co.              | 30,024                 | 35,876                 | 5,852                          | 19                               | 13.7  | 20.1  | 10.0   | 47                                | 46   |
| Mahnomen Co.            | 5,476                  | 5,567                  | 91                             | 2                                | 4.2   | 4.8   | 0.9  | 14                                | 12   |
| Marshall Co.            | 12,584                 | 9,361                  | -3,223                         | -26                              | 17.5  | 19.9  | 3.8  | 14                                | 0  |
| Martin Co.              | 24,919                 | 19,866                 | -5,053                         | -20                              | 14.2  | 16.9  | 4.2  | 19                                | 0  |

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|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Meeker Co.              | 20,841                 | 23,047                 | 2,206                          | 11                               | 12.4  | 15.7  | 5.2  | 27                                | 43   |
| Mille Lacs Co.          | 18,569                 | 25,861                 | 7,292                          | 39                               | 14.3  | 22.6  | 13.0   | 58                                | 72   |
| Morrison Co.            | 29,222                 | 33,084                 | 3,862                          | 13                               | 29.2  | 34.0  | 7.5  | 16                                | 82   |
| Mower Co.               | 39,374                 | 39,773                 | 399                            | 1                                | 20.9  | 23.2  | 3.6  | 11                                | 10   |
| Murray Co.              | 11,207                 | 8,332                  | -2,875                         | -26                              | 9.5   | 10.8  | 2.0  | 14                                | 0  |
| Nicollet Co.            | 27,203                 | 34,052                 | 6,849                          | 25                               | 6.8   | 13.6  | 10.6   | 100                               | 32   |
| Nobles Co.              | 21,540                 | 21,671                 | 131                            | 1                                | 15.8  | 17.3  | 2.3  | 9                                 | 7  |
| Norman Co.              | 9,038                  | 6,589                  | -2,449                         | -27                              | 13.5  | 14.7  | 1.9  | 9                                 | 0  |
| Olmsted Co.             | 94,228                 | 154,727                | 60,499                         | 64                               | 37.9  | 57.0  | 29.8   | 50                                | 100  |
| Otter Tail Co.          | 51,683                 | 58,219                 | 6,536                          | 13                               | 39.4  | 56.6  | 26.9   | 44                                | 33   |
| Pennington Co.          | 14,539                 | 14,178                 | -361                           | -2                               | 11.8  | 13.7  | 3.0  | 16                                | 0  |
| Pine Co.                | 20,202                 | 29,159                 | 8,957                          | 44                               | 23.4  | 29.5  | 9.5  | 26                                | 100  |

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|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Pipestone Co.           | 11,506                 | 9,157                  | -2,349                         | -20                              | 6.9   | 7.7   | 1.3  | 12                                | 0  |
| Polk Co.                | 34,313                 | 31,637                 | -2,676                         | -8                               | 24.1  | 24.2  | 0.2  | 0                                 | 0  |
| Pope Co.                | 11,410                 | 10,988                 | -422                           | -4                               | 15.1  | 19.5  | 6.9  | 29                                | 0  |
| Ramsey Co.              | 467,807                | 544,886                | 77,079                         | 16                               | 57.1  | 67.5  | 16.3   | 18                                | 91   |
| Red Lake Co.            | 5,349                  | 4,009                  | -1,340                         | -25                              | 7.1   | 8.1   | 1.6  | 14                                | 0  |
| Redwood Co.             | 19,222                 | 15,244                 | -3,978                         | -21                              | 14.7  | 16.4  | 2.7  | 12                                | 0  |
| Renville Co.            | 19,896                 | 14,693                 | -5,203                         | -26                              | 17.2  | 18.5  | 2.0  | 8                                 | 0  |
| Rice Co.                | 47,016                 | 66,196                 | 19,180                         | 41                               | 13.0  | 20.5  | 11.7   | 58                                | 75   |
| Rock Co.                | 10,511                 | 9,459                  | -1,052                         | -10                              | 8.4   | 9.4   | 1.6  | 12                                | 0  |
| Roseau Co.              | 12,317                 | 15,305                 | 2,988                          | 24                               | 10.6  | 13.1  | 3.9  | 24                                | 100  |
| St. Louis Co.           | 217,595                | 199,778                | -17,817                        | -8                               | 92.1  | 121.2   | 45.5   | 32                                | 0  |
| Scott Co.               | 45,803                 | 145,535                | 99,732                         | 218                              | 18.7  | 52.9  | 53.4   | 183                               | 100  |

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|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Sherburne Co.           | 31,877                 | 94,476                 | 62,599                         | 196                              | 15.3  | 37.3  | 34.4   | 144                               | 100  |
| Sibley Co.              | 15,331                 | 14,899                 | -432                           | -3                               | 10.1  | 10.6  | 0.8  | 5                                 | 0  |
| Stearns Co.             | 110,132                | 158,301                | 48,169                         | 44                               | 40.3  | 63.5  | 36.3   | 58                                | 80   |
| Steele Co.              | 30,261                 | 36,787                 | 6,526                          | 22                               | 14.3  | 19.6  | 8.3  | 37                                | 62   |
| Stevens Co.             | 11,233                 | 9,706                  | -1,527                         | -14                              | 8.8   | 10.5  | 2.7  | 19                                | 0  |
| Swift Co.               | 12,551                 | 9,387                  | -3,164                         | -25                              | 8.4   | 8.9   | 0.8  | 6                                 | 0  |
| Todd Co.                | 25,027                 | 24,526                 | -501                           | -2                               | 12.5  | 15.8  | 5.2  | 26                                | 0  |
| Traverse Co.            | 5,419                  | 3,304                  | -2,115                         | -39                              | 5.4   | 5.9   | 0.8  | 9                                 | 0  |
| Wabasha Co.             | 19,347                 | 21,590                 | 2,243                          | 12                               | 9.9   | 13.6  | 5.8  | 37                                | 35   |
| Wadena Co.              | 13,992                 | 13,647                 | -345                           | -2                               | 10.4  | 14.5  | 6.4  | 39                                | 0  |
| Waseca Co.              | 18,520                 | 18,713                 | 193                            | 1                                | 8.6   | 10.1  | 2.3  | 17                                | 6  |
| Washington Co.          | 118,856                | 255,464                | 136,608                        | 115                              | 39.4  | 88.3  | 76.4   | 124                               | 95   |

| <b>Minnesota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Watonwan Co.            | 12,361                 | 10,934                 | -1,427                         | -12                              | 7.2   | 8.4   | 1.9  | 17                                | 0  |
| Wilkin Co.              | 8,227                  | 6,322                  | -1,905                         | -23                              | 9.9   | 11.0  | 1.7  | 11                                | 0  |
| Winona Co.              | 46,691                 | 50,718                 | 4,027                          | 9                                | 20.7  | 28.8  | 12.7   | 39                                | 25   |
| Wright Co.              | 60,139                 | 134,205                | 74,066                         | 123                              | 36.5  | 57.5  | 32.8   | 58                                | 100  |
| Yellow Medicine Co.     | 13,342                 | 9,836                  | -3,506                         | -26                              | 13.5  | 15.7  | 3.4  | 16                                | 0  |
| <b>Totals</b>           | <b>4,131,450</b>       | <b>5,566,230</b>       | <b>1,434,780</b>               | <b>35</b>                        | <b>1,727.5</b>                                | <b>2,460.9</b>                                | <b>1,145.9</b>   | <b>42</b>                         | <b>84</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>70</b>                                    |



**Scatter Plot for Minnesota County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.91**

**Mississippi**

| <b>Mississippi County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adams Co.                 | 39,172                 | 31,462                 | -7,710                         | -20                              | 11.2  | 18.7  | 11.7   | 67                                | 0  |
| Alcorn Co.                | 32,661                 | 37,165                 | 4,504                          | 14                               | 10.5  | 22.8  | 19.2   | 117                               | 17   |
| Amite Co.                 | 13,385                 | 12,448                 | -937                           | -7                               | 9.5   | 12.6  | 4.8  | 33                                | 0  |
| Attala Co.                | 19,298                 | 18,467                 | -831                           | -4                               | 2.0   | 9.9   | 12.3   | 395                               | 0  |
| Benton Co.                | 8,118                  | 8,255                  | 137                            | 2                                | 5.1   | 8.4   | 5.2  | 65                                | 3  |
| Bolivar Co.               | 45,212                 | 31,718                 | -13,494                        | -30                              | 14.1  | 16.9  | 4.4  | 20                                | 0  |
| Calhoun Co.               | 15,452                 | 14,508                 | -944                           | -6                               | 8.1   | 11.2  | 4.8  | 38                                | 0  |
| Carroll Co.               | 9,395                  | 10,094                 | 699                            | 7                                | 10.1  | 14.2  | 6.4  | 41                                | 0  |
| Chickasaw Co.             | 17,671                 | 17,144                 | -527                           | -3                               | 5.1   | 17.6  | 19.5   | 245                               | 0  |
| Choctaw Co.               | 8,770                  | 8,240                  | -530                           | -6                               | 5.6   | 7.2   | 2.5  | 29                                | 0  |
| Claiborne Co.             | 12,398                 | 9,026                  | -3,372                         | -27                              | 6.8   | 8.4   | 2.5  | 24                                | 0  |

| Mississippi County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Clarke Co.         | 17,063          | 15,805          | -1,258                  | -7                        | 8.7                                    | 18.1                                   | 14.7  | 108                        | 0                                     |
| Clay Co.           | 21,576          | 19,621          | -1,955                  | -9                        | 8.8                                    | 17.1                                   | 13.0  | 94                         | 0                                     |
| Coahoma Co.        | 35,818          | 23,214          | -12,604                 | -35                       | 10.4                                   | 13.5                                   | 4.8   | 30                         | 0                                     |
| Copiah Co.         | 26,325          | 28,528          | 2,203                   | 8                         | 9.8                                    | 16.5                                   | 10.5  | 68                         | 15                                    |
| Covington Co.      | 16,195          | 19,014          | 2,819                   | 17                        | 10.0                                   | 17.0                                   | 10.9  | 70                         | 30                                    |
| DeSoto Co.         | 54,530          | 179,005         | 124,475                 | 228                       | 23.8                                   | 75.1                                   | 80.2  | 216                        | 100                                   |
| Forrest Co.        | 68,096          | 75,155          | 7,059                   | 10                        | 27.5                                   | 43.7                                   | 25.3  | 59                         | 21                                    |
| Franklin Co.       | 8,389           | 7,754           | -635                    | -8                        | 9.3                                    | 9.5                                    | 0.3   | 2                          | 0                                     |
| George Co.         | 15,829          | 23,951          | 8,122                   | 51                        | 11.0                                   | 22.7                                   | 18.3  | 106                        | 57                                    |
| Greene Co.         | 9,448           | 13,529          | 4,081                   | 43                        | 11.9                                   | 18.9                                   | 10.9  | 59                         | 78                                    |
| Grenada Co.        | 20,913          | 21,037          | 124                     | 1                         | 9.3                                    | 14.7                                   | 8.4   | 58                         | 1                                     |
| Hancock Co.        | 26,356          | 46,949          | 20,593                  | 78                        | 44.3                                   | 55.0                                   | 16.7  | 24                         | 100                                   |

| Mississippi County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Harrison Co.        | 163,369         | 204,966         | 41,597                  | 25                        | 75.4                                   | 109.7                                  | 53.6  | 45                         | 60                                    |
| Hinds Co.           | 254,578         | 239,929         | -14,649                 | -6                        | 81.5                                   | 98.8                                   | 27.0  | 21                         | 0                                     |
| Holmes Co.          | 22,867          | 17,849          | -5,018                  | -22                       | 10.9                                   | 11.9                                   | 1.6   | 9                          | 0                                     |
| Humphreys Co.       | 13,710          | 8,333           | -5,377                  | -39                       | 6.5                                    | 7.9                                    | 2.2   | 22                         | 0                                     |
| Issaquena Co.       | 2,403           | 1,341           | -1,062                  | -44                       | 5.5                                    | 6.0                                    | 0.8   | 9                          | 0                                     |
| Itawamba Co.        | 20,214          | 23,499          | 3,285                   | 16                        | 6.3                                    | 14.7                                   | 13.1  | 133                        | 18                                    |
| Jackson Co.         | 121,261         | 142,246         | 20,985                  | 17                        | 57.3                                   | 81.8                                   | 38.3  | 43                         | 45                                    |
| Jasper Co.          | 17,673          | 16,574          | -1,099                  | -6                        | 6.2                                    | 14.6                                   | 13.1  | 135                        | 0                                     |
| Jefferson Co.       | 9,212           | 7,227           | -1,985                  | -22                       | 5.2                                    | 8.3                                    | 4.8   | 60                         | 0                                     |
| Jefferson Davis Co. | 14,173          | 11,284          | -2,889                  | -20                       | 6.0                                    | 11.3                                   | 8.3   | 88                         | 0                                     |
| Jones Co.           | 64,875          | 68,364          | 3,489                   | 5                         | 35.5                                   | 49.6                                   | 22.0  | 40                         | 16                                    |

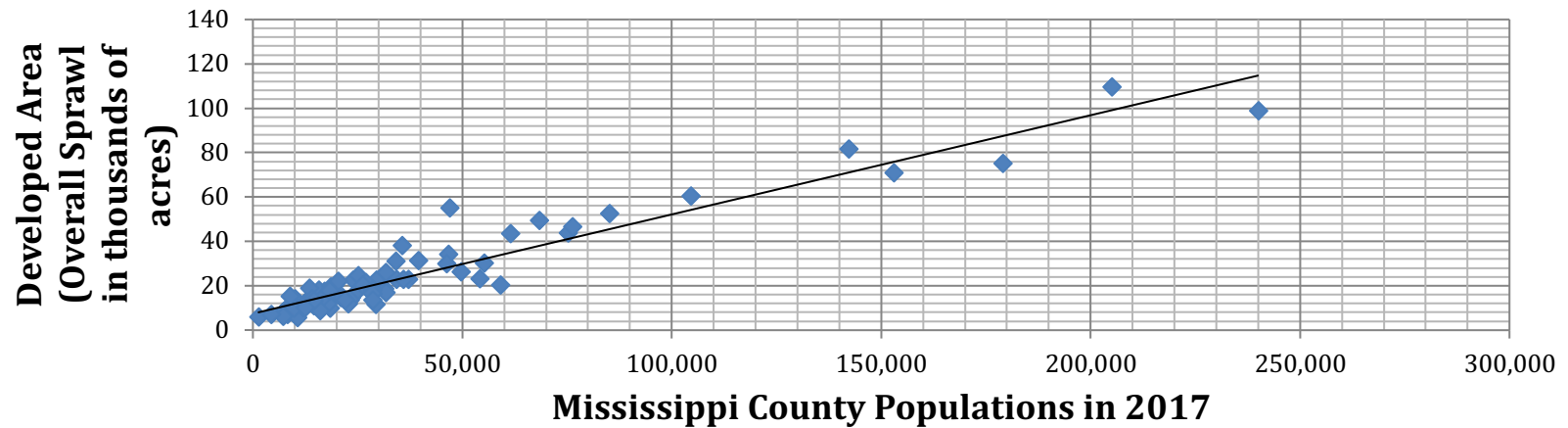
| <b>Mississippi County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Kemper Co.                | 10,222                 | 10,093                 | -129                           | -1                               | 8.5   | 13.2  | 7.3  | 55                                | 0  |
| Lafayette Co.             | 31,248                 | 54,178                 | 22,930                         | 73                               | 9.0   | 23.1  | 22.0   | 157                               | 58   |
| Lamar Co.                 | 26,034                 | 61,536                 | 35,502                         | 136                              | 22.5  | 43.5  | 32.8   | 93                                | 100  |
| Lauderdale Co.            | 78,066                 | 76,309                 | -1,757                         | -2                               | 26.2  | 46.7  | 32.0   | 78                                | 0  |
| Lawrence Co.              | 12,677                 | 12,629                 | -48                            | 0                                | 7.3   | 12.4  | 8.0  | 70                                | 0  |
| Leake Co.                 | 18,716                 | 22,819                 | 4,103                          | 22                               | 5.6   | 11.9  | 9.8  | 113                               | 26   |
| Lee Co.                   | 57,588                 | 85,071                 | 27,483                         | 48                               | 26.7  | 52.5  | 40.3   | 97                                | 58   |
| Leflore Co.               | 42,006                 | 29,292                 | -12,714                        | -30                              | 9.5   | 11.5  | 3.1  | 21                                | 0  |
| Lincoln Co.               | 31,021                 | 34,340                 | 3,319                          | 11                               | 13.1  | 23.0  | 15.5   | 76                                | 18   |
| Lowndes Co.               | 59,430                 | 59,147                 | -283                           | 0                                | 8.6   | 20.4  | 18.4   | 137                               | 0  |
| Madison Co.               | 42,826                 | 104,584                | 61,758                         | 144                              | 18.8  | 60.6  | 65.3   | 222                               | 76   |
| Marion Co.                | 26,767                 | 25,108                 | -1,659                         | -6                               | 14.5  | 24.6  | 15.8   | 70                                | 0  |

| Mississippi County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Marshall Co.       | 29,810          | 35,590          | 5,780                   | 19                        | 14.1                                   | 38.1                                   | 37.5  | 170                        | 18                                    |
| Monroe Co.         | 37,171          | 35,851          | -1,320                  | -4                        | 13.5                                   | 22.8                                   | 14.5  | 69                         | 0                                     |
| Montgomery Co.     | 13,269          | 10,143          | -3,126                  | -24                       | 8.9                                    | 10.7                                   | 2.8   | 20                         | 0                                     |
| Neshoba Co.        | 23,720          | 29,435          | 5,715                   | 24                        | 7.8                                    | 22.6                                   | 23.1  | 190                        | 20                                    |
| Newton Co.         | 19,917          | 21,396          | 1,479                   | 7                         | 7.1                                    | 14.8                                   | 12.0  | 108                        | 10                                    |
| Noxubee Co.        | 13,063          | 10,711          | -2,352                  | -18                       | 3.4                                    | 5.6                                    | 3.4   | 65                         | 0                                     |
| Oktibbeha Co.      | 37,014          | 49,678          | 12,664                  | 34                        | 12.5                                   | 26.4                                   | 21.7  | 111                        | 39                                    |
| Panola Co.         | 28,310          | 34,158          | 5,848                   | 21                        | 18.8                                   | 31.0                                   | 19.1  | 65                         | 38                                    |
| Pearl River Co.    | 35,512          | 55,255          | 19,743                  | 56                        | 17.4                                   | 30.4                                   | 20.3  | 75                         | 79                                    |
| Perry Co.          | 10,015          | 12,014          | 1,999                   | 20                        | 6.7                                    | 10.3                                   | 5.6   | 54                         | 42                                    |
| Pike Co.           | 36,983          | 39,510          | 2,527                   | 7                         | 17.0                                   | 31.3                                   | 22.3  | 84                         | 11                                    |
| Pontotoc Co.       | 20,870          | 31,709          | 10,839                  | 52                        | 15.0                                   | 26.0                                   | 17.2  | 73                         | 76                                    |

| Mississippi County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Prentiss Co.       | 23,942          | 25,215          | 1,273                   | 5                         | 10.8                                   | 18.1                                   | 11.4  | 68                         | 10                                    |
| Quitman Co.        | 12,164          | 7,208           | -4,956                  | -41                       | 5.2                                    | 6.4                                    | 1.9   | 23                         | 0                                     |
| Rankin Co.         | 72,716          | 152,904         | 80,188                  | 110                       | 34.5                                   | 70.8                                   | 56.7  | 105                        | 100                                   |
| Scott Co.          | 24,306          | 28,436          | 4,130                   | 17                        | 12.3                                   | 18.8                                   | 10.2  | 53                         | 37                                    |
| Sharkey Co.        | 8,046           | 4,415           | -3,631                  | -45                       | 6.7                                    | 7.1                                    | 0.6   | 6                          | 0                                     |
| Simpson Co.        | 24,128          | 26,905          | 2,777                   | 12                        | 14.0                                   | 21.6                                   | 11.9  | 54                         | 0                                     |
| Smith Co.          | 14,830          | 16,073          | 1,243                   | 8                         | 3.8                                    | 8.7                                    | 7.7   | 129                        | 10                                    |
| Stone Co.          | 10,237          | 18,593          | 8,356                   | 82                        | 11.6                                   | 19.4                                   | 12.2  | 67                         | 100                                   |
| Sunflower Co.      | 35,409          | 26,142          | -9,267                  | -26                       | 15.7                                   | 20.5                                   | 7.5   | 31                         | 0                                     |
| Tallahatchie Co.   | 16,182          | 14,094          | -2,088                  | -13                       | 11.1                                   | 14.1                                   | 4.7   | 27                         | 0                                     |
| Tate Co.           | 20,302          | 28,581          | 8,279                   | 41                        | 9.2                                    | 18.2                                   | 14.1  | 98                         | 50                                    |
| Tippah Co.         | 18,370          | 21,953          | 3,583                   | 20                        | 7.6                                    | 13.6                                   | 9.4   | 79                         | 31                                    |

| <b>Mississippi County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Tishomingo Co.            | 18,892                 | 19,518                 | 626                            | 3                                | 11.5  | 20.0  | 13.3   | 74                                | 6  |
| Tunica Co.                | 9,435                  | 9,984                  | 549                            | 6                                | 7.5   | 10.7  | 5.0  | 43                                | 16   |
| Union Co.                 | 21,610                 | 28,486                 | 6,876                          | 32                               | 10.3  | 16.6  | 9.8  | 61                                | 58   |
| Walthall Co.              | 13,598                 | 14,505                 | 907                            | 7                                | 8.2   | 13.4  | 8.1  | 63                                | 13   |
| Warren Co.                | 51,620                 | 46,682                 | -4,938                         | -10                              | 23.0  | 34.2  | 17.5   | 49                                | 0  |
| Washington Co.            | 72,636                 | 46,197                 | -26,439                        | -36                              | 26.0  | 29.9  | 6.1  | 15                                | 0  |
| Wayne Co.                 | 19,411                 | 20,430                 | 1,019                          | 5                                | 12.6  | 22.0  | 14.7   | 75                                | 9  |
| Webster Co.               | 10,432                 | 9,732                  | -700                           | -7                               | 7.3   | 9.8   | 3.9  | 34                                | 0  |
| Wilkinson Co.             | 10,148                 | 8,855                  | -1,293                         | -13                              | 10.2  | 15.2  | 7.8  | 49                                | 0  |
| Winston Co.               | 19,120                 | 18,237                 | -883                           | -5                               | 13.3  | 17.8  | 7.0  | 34                                | 0  |
| Yalobusha Co.             | 12,960                 | 12,449                 | -511                           | -4                               | 6.9   | 10.3  | 5.3  | 49                                | 0  |
| Yazoo Co.                 | 27,622                 | 28,659                 | 1,037                          | 4                                | 8.6   | 13.6  | 7.8  | 58                                | 8  |

| Mississippi County      | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Totals</b>           | <b>2,556,776</b> | <b>2,988,510</b> | <b>431,734</b>          | <b>17</b>                 | <b>1,169.6</b>                         | <b>1,948.5</b>                         | <b>1,217.0</b>                                    | <b>67</b>                  | <b>31</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>38</b>                             |



**Scatter Plot for Mississippi County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

R-value: 0.95

**Missouri**

| <b>Missouri County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adair Co.              | 25,361                 | 25,429                 | 68                             | 0                                | 14.3  | 17.3  | 4.7  | 21                                | 1  |
| Andrew Co.             | 14,270                 | 17,474                 | 3,204                          | 22                               | 8.1   | 11.7  | 5.6  | 44                                | 55   |
| Atchison Co.           | 8,793                  | 5,243                  | -3,550                         | -40                              | 8.4   | 8.8   | 0.6  | 5                                 | 0  |
| Audrain Co.            | 25,947                 | 25,590                 | -357                           | -1                               | 17.7  | 19.8  | 3.3  | 12                                | 0  |
| Barry Co.              | 24,833                 | 35,631                 | 10,798                         | 43                               | 20.8  | 33.4  | 19.7   | 61                                | 76   |
| Barton Co.             | 11,189                 | 11,793                 | 604                            | 5                                | 13.0  | 13.9  | 1.4  | 7                                 | 79   |
| Bates Co.              | 15,362                 | 16,293                 | 931                            | 6                                | 13.6  | 14.6  | 1.6  | 7                                 | 83   |
| Benton Co.             | 12,134                 | 19,072                 | 6,938                          | 57                               | 13.5  | 23.9  | 16.3   | 77                                | 79   |
| Bollinger Co.          | 10,192                 | 12,280                 | 2,088                          | 20                               | 5.9   | 7.4   | 2.3  | 25                                | 82   |
| Boone Co.              | 103,024                | 178,012                | 74,988                         | 73                               | 42.6  | 67.3  | 38.6   | 58                                | 100  |
| Buchanan Co.           | 86,284                 | 88,660                 | 2,376                          | 3                                | 35.8  | 42.1  | 9.8  | 18                                | 17   |

| Missouri County    | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Butler Co.         | 37,580          | 42,618          | 5,038                   | 13                        | 27.6                                   | 35.6                                   | 12.5  | 29                         | 49                                    |
| Caldwell Co.       | 8,493           | 9,059           | 566                     | 7                         | 8.0                                    | 9.2                                    | 1.9   | 15                         | 46                                    |
| Callaway Co.       | 32,151          | 44,982          | 12,831                  | 40                        | 22.2                                   | 31.9                                   | 15.2  | 44                         | 93                                    |
| Camden Co.         | 20,977          | 45,473          | 24,496                  | 117                       | 30.8                                   | 43.3                                   | 19.5  | 41                         | 100                                   |
| Cape Girardeau Co. | 59,328          | 78,261          | 18,933                  | 32                        | 24.0                                   | 34.2                                   | 15.9  | 43                         | 78                                    |
| Carroll Co.        | 11,761          | 8,779           | -2,982                  | -25                       | 11.1                                   | 12.0                                   | 1.4   | 8                          | 0                                     |
| Carter Co.         | 5,600           | 6,179           | 579                     | 10                        | 4.6                                    | 8.4                                    | 5.9   | 83                         | 16                                    |
| Cass Co.           | 52,704          | 103,477         | 50,773                  | 96                        | 29.6                                   | 57.7                                   | 43.9  | 95                         | 100                                   |
| Cedar Co.          | 12,064          | 14,070          | 2,006                   | 17                        | 7.9                                    | 10.6                                   | 4.2   | 34                         | 52                                    |
| Chariton Co.       | 10,394          | 7,457           | -2,937                  | -28                       | 14.5                                   | 17.1                                   | 4.1   | 18                         | 0                                     |
| Christian Co.      | 22,791          | 85,392          | 62,601                  | 275                       | 10.8                                   | 36.5                                   | 40.2  | 238                        | 100                                   |

| Missouri County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Clark Co.       | 8,324           | 6,720           | -1,604                  | -19                       | 6.7                                    | 8.1                                    | 2.2   | 21                         | 0                                     |
| Clay Co.        | 137,081         | 242,527         | 105,446                 | 77                        | 48.1                                   | 78.4                                   | 47.3  | 63                         | 100                                   |
| Clinton Co.     | 16,055          | 20,551          | 4,496                   | 28                        | 13.6                                   | 22.0                                   | 13.1  | 62                         | 51                                    |
| Cole Co.        | 58,771          | 76,632          | 17,861                  | 30                        | 22.1                                   | 37.7                                   | 24.4  | 71                         | 50                                    |
| Cooper Co.      | 14,402          | 17,647          | 3,245                   | 23                        | 9.3                                    | 12.1                                   | 4.4   | 30                         | 77                                    |
| Crawford Co.    | 18,254          | 24,107          | 5,853                   | 32                        | 11.8                                   | 23.2                                   | 17.8  | 97                         | 41                                    |
| Dade Co.        | 7,436           | 7,586           | 150                     | 2                         | 8.2                                    | 9.2                                    | 1.6   | 12                         | 17                                    |
| Dallas Co.      | 11,934          | 16,699          | 4,765                   | 40                        | 10.8                                   | 14.4                                   | 5.6   | 33                         | 100                                   |
| Daviess Co.     | 8,715           | 8,358           | -357                    | -4                        | 12.3                                   | 12.4                                   | 0.2   | 1                          | 0                                     |
| DeKalb Co.      | 8,364           | 12,532          | 4,168                   | 50                        | 6.6                                    | 8.7                                    | 3.3   | 32                         | 100                                   |
| Dent Co.        | 14,602          | 15,497          | 895                     | 6                         | 8.4                                    | 10.0                                   | 2.5   | 19                         | 34                                    |
| Douglas Co.     | 11,777          | 13,276          | 1,499                   | 13                        | 7.5                                    | 9.4                                    | 3.0   | 25                         | 53                                    |

| <b>Missouri County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Dunklin Co.            | 35,894                 | 30,121                 | -5,773                         | -16                              | 22.5  | 25.5  | 4.7  | 13                                | 0  |
| Franklin Co.           | 71,873                 | 103,315                | 31,442                         | 44                               | 49.7  | 73.0  | 36.4   | 47                                | 94   |
| Gasconade Co.          | 13,346                 | 14,683                 | 1,337                          | 10                               | 7.3   | 10.3  | 4.7  | 41                                | 28   |
| Gentry Co.             | 7,954                  | 6,634                  | -1,320                         | -17                              | 11.6  | 11.9  | 0.5  | 3                                 | 0  |
| Greene Co.             | 187,459                | 289,512                | 102,053                        | 54                               | 80.2  | 110.0   | 46.6   | 37                                | 100  |
| Grundy Co.             | 11,757                 | 9,991                  | -1,766                         | -15                              | 8.5   | 9.7   | 1.9  | 14                                | 0  |
| Harrison Co.           | 9,941                  | 8,506                  | -1,435                         | -14                              | 19.4  | 20.2  | 1.3  | 4                                 | 0  |
| Henry Co.              | 19,466                 | 21,695                 | 2,229                          | 11                               | 14.5  | 18.0  | 5.5  | 24                                | 50   |
| Hickory Co.            | 6,410                  | 9,395                  | 2,985                          | 47                               | 8.5   | 11.3  | 4.4  | 33                                | 100  |
| Holt Co.               | 6,723                  | 4,407                  | -2,316                         | -34                              | 6.9   | 6.6   | -0.5   | -4                                | 0  |
| Howard Co.             | 10,029                 | 10,066                 | 37                             | 0                                | 9.2   | 11.4  | 3.4  | 24                                | 2  |
| Howell Co.             | 29,067                 | 40,074                 | 11,007                         | 38                               | 15.0  | 24.2  | 14.4   | 61                                | 67   |

| <b>Missouri County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Iron Co.               | 11,002                 | 10,181                 | -821                           | -7                               | 10.9  | 12.3  | 2.2  | 13                                | 0  |
| Jackson Co.            | 628,064                | 698,072                | 70,008                         | 11                               | 109.8   | 164.9   | 86.1   | 50                                | 26   |
| Jasper Co.             | 88,218                 | 120,048                | 31,830                         | 36                               | 45.6  | 63.4  | 27.8   | 39                                | 93   |
| Jefferson Co.          | 149,113                | 223,769                | 74,656                         | 50                               | 63.3  | 108.3   | 70.3   | 71                                | 76   |
| Johnson Co.            | 38,819                 | 53,735                 | 14,916                         | 38                               | 18.8  | 31.3  | 19.5   | 66                                | 64   |
| Knox Co.               | 5,437                  | 3,970                  | -1,467                         | -27                              | 7.1   | 7.1   | 0.0  | 0                                 | 0  |
| Laclede Co.            | 24,568                 | 35,418                 | 10,850                         | 44                               | 15.6  | 22.9  | 11.4   | 47                                | 95   |
| Lafayette Co.          | 29,860                 | 32,579                 | 2,719                          | 9                                | 20.5  | 23.8  | 5.2  | 16                                | 58   |
| Lawrence Co.           | 28,662                 | 38,256                 | 9,594                          | 33                               | 17.3  | 26.5  | 14.4   | 53                                | 68   |
| Lewis Co.              | 11,214                 | 9,952                  | -1,262                         | -11                              | 7.2   | 8.9   | 2.7  | 24                                | 0  |
| Lincoln Co.            | 22,576                 | 56,045                 | 33,469                         | 148                              | 17.3  | 33.0  | 24.5   | 91                                | 100  |
| Linn Co.               | 15,574                 | 12,168                 | -3,406                         | -22                              | 13.1  | 13.2  | 0.2  | 1                                 | 0  |

| <b>Missouri County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Livingston Co.         | 15,597                 | 15,157                 | -440                           | -3                               | 9.5   | 12.1  | 4.1  | 27                                | 0  |
| McDonald Co.           | 15,151                 | 22,722                 | 7,571                          | 50                               | 10.3  | 18.7  | 13.1   | 82                                | 68   |
| Macon Co.              | 16,517                 | 15,262                 | -1,255                         | -8                               | 10.7  | 13.9  | 5.0  | 30                                | 0  |
| Madison Co.            | 10,735                 | 12,230                 | 1,495                          | 14                               | 4.8   | 7.9   | 4.8  | 65                                | 26   |
| Maries Co.             | 7,655                  | 8,790                  | 1,135                          | 15                               | 6.6   | 8.2   | 2.5  | 24                                | 64   |
| Marion Co.             | 28,920                 | 28,585                 | -335                           | -1                               | 20.0  | 23.8  | 5.9  | 19                                | 0  |
| Mercer Co.             | 4,744                  | 3,656                  | -1,088                         | -23                              | 6.7   | 7.3   | 0.9  | 9                                 | 0  |
| Miller Co.             | 19,011                 | 25,202                 | 6,191                          | 33                               | 12.1  | 17.0  | 7.7  | 40                                | 83   |
| Mississippi Co.        | 15,768                 | 13,594                 | -2,174                         | -14                              | 8.0   | 9.5   | 2.3  | 19                                | 0  |
| Moniteau Co.           | 12,273                 | 16,047                 | 3,774                          | 31                               | 10.4  | 11.9  | 2.3  | 14                                | 100  |
| Monroe Co.             | 9,694                  | 8,596                  | -1,098                         | -11                              | 6.8   | 7.2   | 0.6  | 6                                 | 0  |
| Montgomery Co.         | 11,432                 | 11,378                 | -54                            | 0                                | 8.1   | 9.7   | 2.5  | 20                                | 0  |

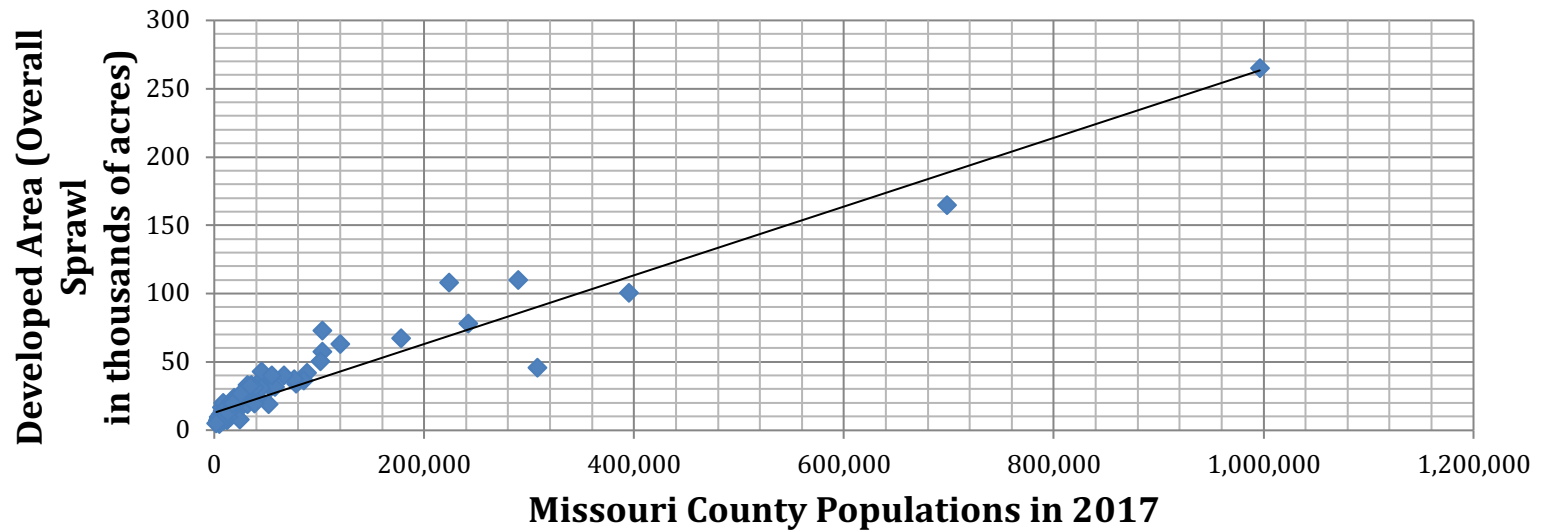
| <b>Missouri County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Morgan Co.             | 14,110                 | 20,162                 | 6,052                          | 43                               | 11.7  | 15.9  | 6.6  | 36                                | 100  |
| New Madrid Co.         | 22,789                 | 17,544                 | -5,245                         | -23                              | 17.4  | 19.9  | 3.9  | 14                                | 0  |
| Newton Co.             | 41,008                 | 58,191                 | 17,183                         | 42                               | 17.5  | 31.9  | 22.5   | 82                                | 58   |
| Nodaway Co.            | 22,558                 | 22,401                 | -157                           | -1                               | 16.7  | 19.3  | 4.1  | 16                                | 0  |
| Oregon Co.             | 9,969                  | 10,553                 | 584                            | 6                                | 9.9   | 14.1  | 6.6  | 42                                | 16   |
| Osage Co.              | 12,016                 | 13,658                 | 1,642                          | 14                               | 7.3   | 9.0   | 2.7  | 23                                | 61   |
| Ozark Co.              | 8,048                  | 9,227                  | 1,179                          | 15                               | 9.9   | 12.3  | 3.8  | 24                                | 63   |
| Pemiscot Co.           | 24,387                 | 16,783                 | -7,604                         | -31                              | 17.4  | 21.2  | 5.9  | 22                                | 0  |
| Perry Co.              | 16,739                 | 19,262                 | 2,523                          | 15                               | 11.6  | 17.3  | 8.9  | 49                                | 35   |
| Pettis Co.             | 35,658                 | 42,445                 | 6,787                          | 19                               | 19.6  | 23.9  | 6.7  | 22                                | 88   |
| Phelps Co.             | 34,676                 | 44,551                 | 9,875                          | 28                               | 23.8  | 30.7  | 10.8   | 29                                | 98   |
| Pike Co.               | 17,182                 | 18,557                 | 1,375                          | 8                                | 10.7  | 12.3  | 2.5  | 15                                | 55   |

| Missouri County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Platte Co.      | 47,914          | 101,141         | 53,227                  | 111                       | 33.3                                   | 50.8                                   | 27.3  | 53                         | 100                                   |
| Polk Co.        | 19,389          | 31,742          | 12,353                  | 64                        | 12.4                                   | 19.0                                   | 10.3  | 53                         | 100                                   |
| Pulaski Co.     | 42,853          | 51,862          | 9,009                   | 21                        | 12.6                                   | 19.4                                   | 10.6  | 54                         | 44                                    |
| Putnam Co.      | 6,006           | 4,778           | -1,228                  | -20                       | 9.3                                    | 9.9                                    | 0.9   | 6                          | 0                                     |
| Ralls Co.       | 8,888           | 10,226          | 1,338                   | 15                        | 5.1                                    | 8.0                                    | 4.5   | 57                         | 31                                    |
| Randolph Co.    | 25,436          | 24,899          | -537                    | -2                        | 6.8                                    | 7.8                                    | 1.6   | 15                         | 0                                     |
| Ray Co.         | 21,452          | 22,877          | 1,425                   | 7                         | 17.9                                   | 21.5                                   | 5.6   | 20                         | 35                                    |
| Reynolds Co.    | 7,172           | 6,260           | -912                    | -13                       | 8.1                                    | 9.2                                    | 1.7   | 14                         | 0                                     |
| Ripley Co.      | 12,273          | 13,565          | 1,292                   | 11                        | 6.9                                    | 9.9                                    | 4.7   | 43                         | 28                                    |
| St. Charles Co. | 152,898         | 395,130         | 242,232                 | 158                       | 54.8                                   | 100.6                                  | 71.6  | 84                         | 100                                   |
| St. Clair Co.   | 8,613           | 9,365           | 752                     | 9                         | 7.3                                    | 8.9                                    | 2.5   | 22                         | 42                                    |

| <b>Missouri County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Ste. Genevieve Co.     | 15,069                 | 17,792                 | 2,723                          | 18                               | 11.5  | 18.8  | 11.4   | 63                                | 34   |
| St. Francois Co.       | 42,461                 | 66,674                 | 24,213                         | 57                               | 31.7  | 40.5  | 13.8   | 28                                | 100  |
| St. Louis Co.          | 978,444                | 996,227                | 17,783                         | 2                                | 211.1   | 265.3   | 84.7   | 26                                | 8  |
| Saline Co.             | 24,871                 | 22,910                 | -1,961                         | -8                               | 18.3  | 20.4  | 3.3  | 11                                | 0  |
| Schuyler Co.           | 4,889                  | 4,518                  | -371                           | -8                               | 7.5   | 8.3   | 1.3  | 11                                | 0  |
| Scotland Co.           | 5,420                  | 4,948                  | -472                           | -9                               | 4.8   | 4.9   | 0.2  | 2                                 | 0  |
| Scott Co.              | 39,615                 | 38,576                 | -1,039                         | -3                               | 24.9  | 31.3  | 10.0   | 26                                | 0  |
| Shannon Co.            | 7,953                  | 8,235                  | 282                            | 4                                | 10.4  | 13.9  | 5.5  | 34                                | 12   |
| Shelby Co.             | 7,792                  | 5,995                  | -1,797                         | -23                              | 8.7   | 9.4   | 1.1  | 8                                 | 0  |
| Stoddard Co.           | 28,505                 | 29,364                 | 859                            | 3                                | 23.4  | 26.9  | 5.5  | 15                                | 21   |
| Stone Co.              | 15,859                 | 31,642                 | 15,783                         | 100                              | 22.8  | 33.4  | 16.6   | 46                                | 100  |

| Missouri County | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Sullivan Co.    | 7,224            | 6,212            | -1,012                  | -14                       | 7.0                                    | 7.9                                    | 1.4   | 13                         | 0                                     |
| Taney Co.       | 21,413           | 55,100           | 33,687                  | 157                       | 18.0                                   | 40.1                                   | 34.5  | 123                        | 100                                   |
| Texas Co.       | 21,078           | 25,650           | 4,572                   | 22                        | 19.3                                   | 24.7                                   | 8.4   | 28                         | 80                                    |
| Vernon Co.      | 19,504           | 20,507           | 1,003                   | 5                         | 16.7                                   | 20.5                                   | 5.9   | 23                         | 24                                    |
| Warren Co.      | 15,586           | 34,448           | 18,862                  | 121                       | 23.2                                   | 32.3                                   | 14.2  | 39                         | 100                                   |
| Washington Co.  | 18,138           | 24,994           | 6,856                   | 38                        | 10.7                                   | 26.9                                   | 25.3  | 151                        | 35                                    |
| Wayne Co.       | 11,351           | 13,303           | 1,952                   | 17                        | 9.4                                    | 12.9                                   | 5.5   | 37                         | 50                                    |
| Webster Co.     | 20,739           | 38,745           | 18,006                  | 87                        | 10.8                                   | 19.8                                   | 14.1  | 83                         | 100                                   |
| Worth Co.       | 3,020            | 2,041            | -979                    | -32                       | 4.9                                    | 5.2                                    | 0.5   | 6                          | 0                                     |
| Wright Co.      | 16,349           | 18,210           | 1,861                   | 11                        | 15.3                                   | 19.7                                   | 6.9   | 29                         | 43                                    |
| St. Louis city  | 434,672          | 308,233          | -126,439                | -29                       | 45.5                                   | 45.9                                   | 0.6   | 1                          | 0                                     |
| <b>Totals</b>   | <b>4,929,456</b> | <b>6,106,670</b> | <b>1,177,214</b>        | <b>24</b>                 | <b>2,167.9</b>                         | <b>3,019.0</b>                         | <b>1,329.8</b>                                    | <b>39</b>                  | <b>65</b>                             |

| Missouri County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Weighted Average |                 |                 |                         |                           |  |  |   |                            | 66                                    |



**Scatter Plot for Missouri County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

R-value: 0.95

**Montana**

| Montana County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Beaverhead Co. | 8,674           | 9,450           | 776                     | 9                         | 18.8                                   | 24.0                                   | 8.1   | 28                         | 35                                    |
| Big Horn Co.   | 10,961          | 13,483          | 2,522                   | 23                        | 19.3                                   | 21.3                                   | 3.1   | 10                         | 100                                   |
| Blaine Co.     | 6,959           | 6,745           | -214                    | -3                        | 16.7                                   | 17.1                                   | 0.6   | 2                          | 0                                     |
| Broadwater Co. | 3,301           | 5,917           | 2,616                   | 79                        | 10.1                                   | 20.8                                   | 16.7  | 106                        | 81                                    |
| Carbon Co.     | 8,342           | 10,680          | 2,338                   | 28                        | 9.6                                    | 10.7                                   | 1.7   | 11                         | 100                                   |
| Carter Co.     | 1,738           | 1,223           | -515                    | -30                       | 14.8                                   | 16.5                                   | 2.7   | 11                         | 0                                     |
| Cascade Co.    | 79,791          | 81,633          | 1,842                   | 2                         | 33.4                                   | 37.4                                   | 6.3   | 12                         | 20                                    |
| Chouteau Co.   | 6,139           | 5,732           | -407                    | -7                        | 17.7                                   | 20.8                                   | 4.8   | 18                         | 0                                     |
| Custer Co.     | 13,080          | 11,726          | -1,354                  | -10                       | 19.9                                   | 20.6                                   | 1.1   | 4                          | 0                                     |
| Daniels Co.    | 2,775           | 1,722           | -1,053                  | -38                       | 8.1                                    | 8.2                                    | 0.2   | 1                          | 0                                     |
| Dawson Co.     | 12,414          | 8,952           | -3,462                  | -28                       | 17.9                                   | 21.1                                   | 5.0   | 18                         | 0                                     |

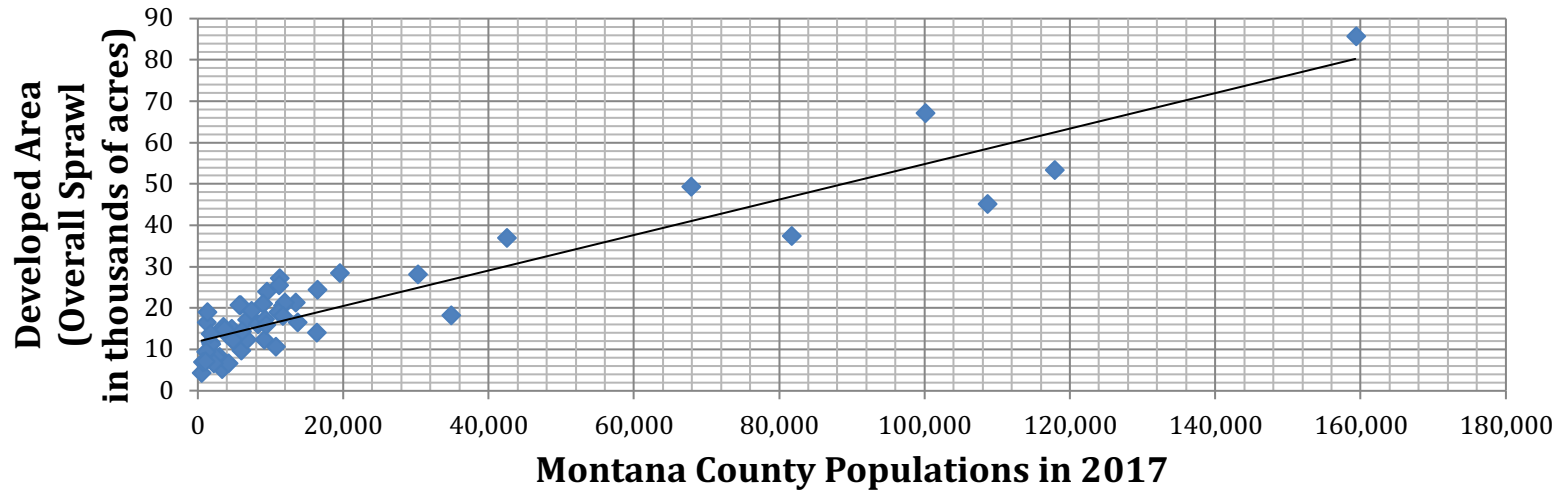
| Montana County    | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Deer Lodge Co.    | 11,386          | 9,100           | -2,286                  | -20                       | 7.6                                    | 12.4                                   | 7.5   | 63                         | 0                                     |
| Fallon Co.        | 3,773           | 3,004           | -769                    | -20                       | 10.1                                   | 8.2                                    | -3.0  | -19                        | 100                                   |
| Fergus Co.        | 13,026          | 11,281          | -1,745                  | -13                       | 23.7                                   | 27.2                                   | 5.5   | 15                         | 0                                     |
| Flathead Co.      | 52,662          | 100,091         | 47,429                  | 90                        | 28.5                                   | 67.2                                   | 60.5  | 136                        | 75                                    |
| Gallatin Co.      | 45,372          | 108,576         | 63,204                  | 139                       | 20.8                                   | 45.2                                   | 38.1  | 117                        | 100                                   |
| Garfield Co.      | 1,656           | 1,281           | -375                    | -23                       | 17.6                                   | 19.1                                   | 2.3   | 9                          | 0                                     |
| Glacier Co.       | 10,817          | 13,732          | 2,915                   | 27                        | 15.1                                   | 16.6                                   | 2.3   | 10                         | 100                                   |
| Golden Valley Co. | 1,062           | 817             | -245                    | -23                       | 7.8                                    | 6.9                                    | -1.4  | -12                        | 100                                   |
| Granite Co.       | 2,648           | 3,356           | 708                     | 27                        | 4.4                                    | 5.2                                    | 1.3   | 18                         | 100                                   |
| Hill Co.          | 18,440          | 16,469          | -1,971                  | -11                       | 23.6                                   | 24.5                                   | 1.4   | 4                          | 0                                     |
| Jefferson Co.     | 7,353           | 11,921          | 4,568                   | 62                        | 17.7                                   | 21.3                                   | 5.6   | 20                         | 100                                   |

| Montana County      | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Judith Basin Co.    | 2,640           | 1,945           | -695                    | -26                       | 7.8                                    | 8.0                                    | 0.3   | 3                          | 0                                     |
| Lake Co.            | 19,509          | 30,221          | 10,712                  | 55                        | 14.9                                   | 28.2                                   | 20.8  | 89                         | 69                                    |
| Lewis and Clark Co. | 44,767          | 67,850          | 23,083                  | 52                        | 28.7                                   | 49.3                                   | 32.2  | 72                         | 18                                    |
| Liberty Co.         | 2,406           | 2,407           | 1                       | 0                         | 8.1                                    | 8.2                                    | 0.2   | 1                          | 3                                     |
| Lincoln Co.         | 17,967          | 19,556          | 1,589                   | 9                         | 20.2                                   | 28.5                                   | 13.0  | 41                         | 25                                    |
| McCone Co.          | 2,819           | 1,698           | -1,121                  | -40                       | 11.7                                   | 11.7                                   | 0.0   | 0                          | 0                                     |
| Madison Co.         | 5,820           | 8,291           | 2,471                   | 42                        | 14.2                                   | 16.1                                   | 3.0   | 13                         | 100                                   |
| Meagher Co.         | 2,202           | 1,852           | -350                    | -16                       | 10.9                                   | 11.3                                   | 0.6   | 4                          | 0                                     |
| Mineral Co.         | 3,503           | 4,235           | 732                     | 21                        | 4.4                                    | 6.6                                    | 3.4   | 50                         | 47                                    |
| Missoula Co.        | 75,242          | 117,834         | 42,592                  | 57                        | 33.4                                   | 53.4                                   | 31.3  | 60                         | 96                                    |
| Musselshell Co.     | 4,708           | 4,632           | -76                     | -2                        | 13.8                                   | 15.0                                   | 1.9   | 9                          | 0                                     |

| Montana County   | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Park Co.         | 13,568          | 16,386          | 2,818                   | 21                        | 10.1                                   | 14.0                                   | 6.1   | 39                         | 58                                    |
| Petroleum Co.    | 637             | 512             | -125                    | -20                       | 4.3                                    | 4.4                                    | 0.2   | 2                          | 0                                     |
| Phillips Co.     | 5,424           | 4,113           | -1,311                  | -24                       | 12.9                                   | 13.4                                   | 0.8   | 4                          | 0                                     |
| Pondera Co.      | 6,864           | 5,968           | -896                    | -13                       | 8.8                                    | 9.7                                    | 1.4   | 10                         | 0                                     |
| Powder River Co. | 2,485           | 1,750           | -735                    | -30                       | 14.1                                   | 13.8                                   | -0.5  | -2                         | 0                                     |
| Powell Co.       | 6,802           | 6,789           | -13                     | 0                         | 12.1                                   | 12.4                                   | 0.5   | 2                          | 0                                     |
| Prairie Co.      | 1,857           | 1,099           | -758                    | -41                       | 8.8                                    | 9.4                                    | 0.9   | 7                          | 0                                     |
| Ravalli Co.      | 23,668          | 42,524          | 18,856                  | 80                        | 11.6                                   | 37.0                                   | 39.7  | 219                        | 51                                    |
| Richland Co.     | 14,208          | 11,027          | -3,181                  | -22                       | 16.7                                   | 19.0                                   | 3.6   | 14                         | 0                                     |
| Roosevelt Co.    | 10,932          | 11,160          | 228                     | 2                         | 17.4                                   | 25.6                                   | 12.8  | 47                         | 5                                     |
| Rosebud Co.      | 12,180          | 9,205           | -2,975                  | -24                       | 13.7                                   | 17.4                                   | 5.8   | 27                         | 0                                     |
| Sanders Co.      | 9,037           | 11,689          | 2,652                   | 29                        | 12.4                                   | 18.1                                   | 8.9   | 46                         | 68                                    |

| Montana County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Sheridan Co.    | 5,894           | 3,471           | -2,423                  | -41                       | 14.6                                   | 15.5                                   | 1.4   | 6                          | 0                                     |
| Silver Bow Co.  | 37,342          | 34,811          | -2,531                  | -7                        | 14.1                                   | 18.2                                   | 6.4   | 29                         | 0                                     |
| Stillwater Co.  | 5,819           | 9,419           | 3,600                   | 62                        | 12.9                                   | 15.9                                   | 4.7   | 23                         | 100                                   |
| Sweet Grass Co. | 3,305           | 3,676           | 371                     | 11                        | 11.6                                   | 14.8                                   | 5.0   | 28                         | 44                                    |
| Teton Co.       | 6,703           | 6,091           | -612                    | -9                        | 13.2                                   | 14.4                                   | 1.9   | 9                          | 0                                     |
| Toole Co.       | 5,588           | 4,860           | -728                    | -13                       | 12.1                                   | 12.2                                   | 0.2   | 1                          | 0                                     |
| Treasure Co.    | 1,044           | 673             | -371                    | -36                       | 5.9                                    | 6.9                                    | 1.6   | 17                         | 0                                     |
| Valley Co.      | 9,696           | 7,402           | -2,294                  | -24                       | 18.9                                   | 19.4                                   | 0.8   | 3                          | 0                                     |
| Wheatland Co.   | 2,290           | 2,161           | -129                    | -6                        | 6.7                                    | 6.7                                    | 0.0   | 0                          | 0                                     |
| Wibaux Co.      | 1,556           | 1,018           | -538                    | -35                       | 7.7                                    | 7.1                                    | -0.9  | -8                         | 0                                     |
| Yellowstone Co. | 113,071         | 159,266         | 46,195                  | 41                        | 61.7                                   | 85.7                                   | 37.5  | 39                         | 100                                   |
| Yellowstone NP  | 62              |                 | -62                     | -100                      |  |  | 0.0   | N/A                        | 23                                    |

| Montana County          | 1982 Population | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-----------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Totals</b>           | <b>803,984</b>  | <b>1,052,482</b> | <b>248,498</b>          | <b>31</b>                 | <b>853.6</b>                           | <b>1,119.6</b>                         | <b>415.6</b>                                      | <b>31</b>                  | <b>99</b>                             |
| <b>Weighted Average</b> |                 |                  |                         |                           |  |  |   |                            | <b>59</b>                             |



**Scatter Plot for Montana County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.93**

**Nebraska**

| Nebraska County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Adams Co.       | 31,203          | 31,808          | 605                     | 2                         | 19.4                                   | 23.3                                   | 6.1   | 20                         | 10                                    |
| Antelope Co.    | 8,633           | 6,341           | -2,292                  | -27                       | 8.5                                    | 9.1                                    | 0.9   | 7                          | 0                                     |
| Arthur Co.      | 516             | 455             | -61                     | -12                       | 4.9                                    | 4.9                                    | 0.0   | 0                          | 14                                    |
| Banner Co.      | 928             | 726             | -202                    | -22                       | 4.6                                    | 5.3                                    | 1.1   | 15                         | 0                                     |
| Blaine Co.      | 810             | 479             | -331                    | -41                       | 3.1                                    | 3.5                                    | 0.6   | 13                         | 0                                     |
| Boone Co.       | 7,291           | 5,320           | -1,971                  | -27                       | 9.9                                    | 11.8                                   | 3.0   | 19                         | 0                                     |
| Box Butte Co.   | 13,984          | 10,835          | -3,149                  | -23                       | 13.8                                   | 13.8                                   | 0.0   | 0                          | 0                                     |
| Boyd Co.        | 3,227           | 1,955           | -1,272                  | -39                       | 6.1                                    | 6.5                                    | 0.6   | 7                          | 0                                     |
| Brown Co.       | 4,406           | 3,000           | -1,406                  | -32                       | 7.0                                    | 6.7                                    | -0.5  | -4                         | 0                                     |
| Buffalo Co.     | 36,290          | 49,350          | 13,060                  | 36                        | 21.4                                   | 30.9                                   | 14.8  | 44                         | 84                                    |
| Burt Co.        | 8,548           | 6,531           | -2,017                  | -24                       | 9.5                                    | 10.4                                   | 1.4   | 9                          | 0                                     |

| Nebraska County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Butler Co.      | 9,299           | 8,032           | -1,267                  | -14                       | 8.4                                    | 8.9                                    | 0.8   | 6                          | 0                                     |
| Cass Co.        | 20,550          | 25,935          | 5,385                   | 26                        | 11.1                                   | 15.3                                   | 6.6   | 38                         | 73                                    |
| Cedar Co.       | 11,072          | 8,515           | -2,557                  | -23                       | 11.8                                   | 12.8                                   | 1.6   | 8                          | 0                                     |
| Chase Co.       | 4,833           | 3,928           | -905                    | -19                       | 6.6                                    | 6.8                                    | 0.3   | 3                          | 0                                     |
| Cherry Co.      | 6,763           | 5,790           | -973                    | -14                       | 17.7                                   | 18.6                                   | 1.4   | 5                          | 0                                     |
| Cheyenne Co.    | 9,926           | 9,644           | -282                    | -3                        | 22.8                                   | 23.1                                   | 0.5   | 1                          | 0                                     |
| Clay Co.        | 7,954           | 6,186           | -1,768                  | -22                       | 13.9                                   | 14.4                                   | 0.8   | 4                          | 0                                     |
| Colfax Co.      | 9,818           | 10,700          | 882                     | 9                         | 7.9                                    | 8.5                                    | 0.9   | 8                          | 100                                   |
| Cuming Co.      | 11,494          | 8,947           | -2,547                  | -22                       | 9.8                                    | 10.4                                   | 0.9   | 6                          | 0                                     |
| Custer Co.      | 13,852          | 10,869          | -2,983                  | -22                       | 18.8                                   | 19.4                                   | 0.9   | 3                          | 0                                     |
| Dakota Co.      | 16,918          | 20,010          | 3,092                   | 18                        | 8.8                                    | 10.6                                   | 2.8   | 20                         | 90                                    |
| Dawes Co.       | 9,527           | 8,888           | -639                    | -7                        | 12.2                                   | 13.3                                   | 1.7   | 9                          | 0                                     |

| Nebraska County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Dawson Co.      | 22,141          | 23,657          | 1,516                   | 7                         | 13.7                                   | 19.2                                   | 8.6   | 40                         | 20                                    |
| Deuel Co.       | 2,389           | 1,861           | -528                    | -22                       | 7.4                                    | 8.3                                    | 1.4   | 12                         | 0                                     |
| Dixon Co.       | 7,021           | 5,746           | -1,275                  | -18                       | 8.4                                    | 9.1                                    | 1.1   | 8                          | 0                                     |
| Dodge Co.       | 35,820          | 36,789          | 969                     | 3                         | 7.4                                    | 13.0                                   | 8.8   | 76                         | 5                                     |
| Douglas Co.     | 399,782         | 560,733         | 160,951                 | 40                        | 88.0                                   | 118.6                                  | 47.8  | 35                         | 100                                   |
| Dundy Co.       | 2,868           | 1,783           | -1,085                  | -38                       | 6.1                                    | 6.2                                    | 0.2   | 2                          | 0                                     |
| Fillmore Co.    | 7,820           | 5,561           | -2,259                  | -29                       | 12.0                                   | 12.8                                   | 1.3   | 7                          | 0                                     |
| Franklin Co.    | 4,376           | 2,974           | -1,402                  | -32                       | 8.5                                    | 8.6                                    | 0.2   | 1                          | 0                                     |
| Frontier Co.    | 3,610           | 2,623           | -987                    | -27                       | 6.0                                    | 6.5                                    | 0.8   | 8                          | 91                                    |
| Furnas Co.      | 6,444           | 4,763           | -1,681                  | -26                       | 7.7                                    | 7.9                                    | 0.3   | 3                          | 0                                     |
| Gage Co.        | 24,170          | 21,621          | -2,549                  | -11                       | 15.1                                   | 18.9                                   | 5.9   | 25                         | 0                                     |
| Garden Co.      | 2,759           | 1,890           | -869                    | -31                       | 8.0                                    | 7.5                                    | -0.8  | -6                         | 0                                     |

| Nebraska County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Garfield Co.    | 2,326           | 1,986           | -340                    | -15                       | 2.5                                    | 2.6                                    | 0.2   | 4                          | 0                                     |
| Gosper Co.      | 2,155           | 2,028           | -127                    | -6                        | 4.2                                    | 4.5                                    | 0.5   | 7                          | 0                                     |
| Grant Co.       | 856             | 649             | -207                    | -24                       | 2.8                                    | 3.1                                    | 0.5   | 11                         | 0                                     |
| Greeley Co.     | 3,374           | 2,363           | -1,011                  | -30                       | 4.2                                    | 3.8                                    | -0.6  | -10                        | 0                                     |
| Hall Co.        | 49,344          | 61,201          | 11,857                  | 24                        | 27.6                                   | 30.4                                   | 4.4   | 10                         | 100                                   |
| Hamilton Co.    | 9,361           | 9,194           | -167                    | -2                        | 10.9                                   | 13.5                                   | 4.1   | 24                         | 0                                     |
| Harlan Co.      | 4,269           | 3,415           | -854                    | -20                       | 7.6                                    | 6.2                                    | -2.2  | -18                        | 0                                     |
| Hayes Co.       | 1,308           | 893             | -415                    | -32                       | 4.6                                    | 4.4                                    | -0.3  | -4                         | 0                                     |
| Hitchcock Co.   | 4,122           | 2,806           | -1,316                  | -32                       | 6.6                                    | 7.0                                    | 0.6   | 6                          | 0                                     |
| Holt Co.        | 13,698          | 10,182          | -3,516                  | -26                       | 23.2                                   | 23.6                                   | 0.6   | 2                          | 0                                     |
| Hooker Co.      | 984             | 666             | -318                    | -32                       | 1.8                                    | 2.4                                    | 0.9   | 33                         | 0                                     |
| Howard Co.      | 6,665           | 6,396           | -269                    | -4                        | 7.8                                    | 8.2                                    | 0.6   | 5                          | 0                                     |

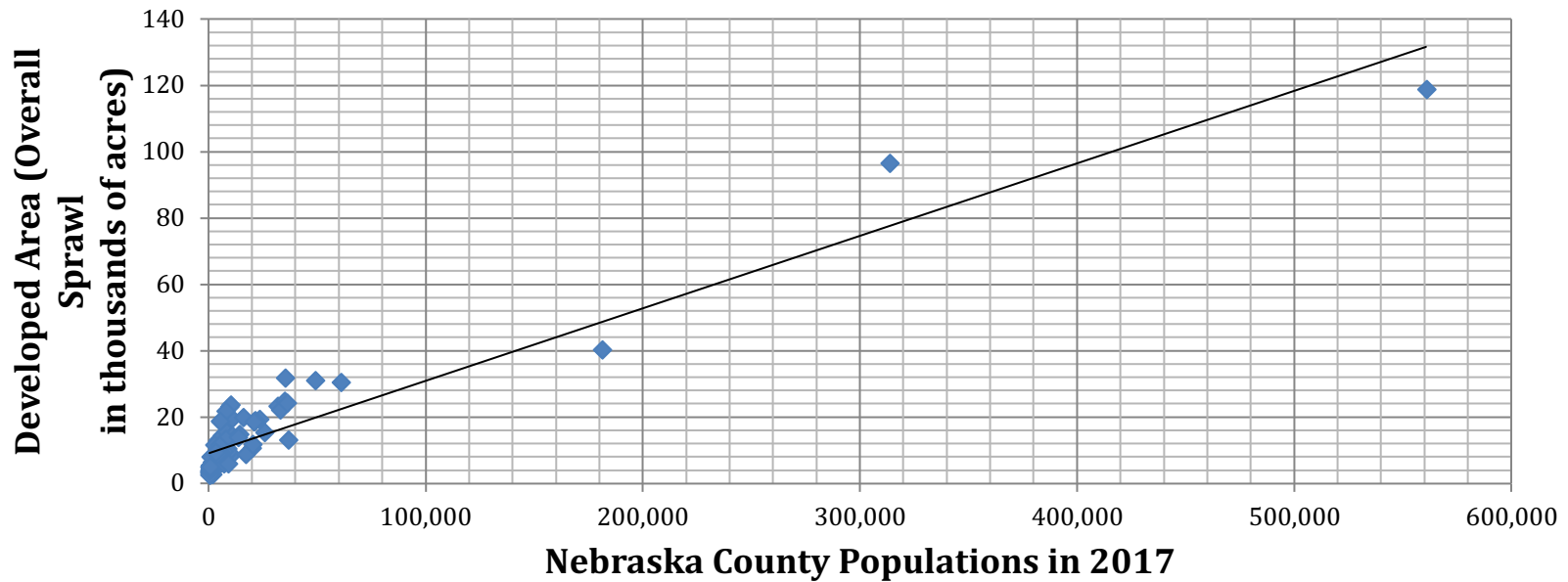
| Nebraska County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Jefferson Co.   | 9,593           | 7,176           | -2,417                  | -25                       | 9.5                                    | 9.8                                    | 0.5   | 3                          | 0                                     |
| Johnson Co.     | 5,135           | 5,169           | 34                      | 1                         | 5.8                                    | 6.8                                    | 1.6   | 17                         | 4                                     |
| Kearney Co.     | 7,105           | 6,492           | -613                    | -9                        | 7.1                                    | 7.3                                    | 0.3   | 3                          | 0                                     |
| Keith Co.       | 9,313           | 8,070           | -1,243                  | -13                       | 15.1                                   | 21.8                                   | 10.5  | 44                         | 0                                     |
| Keya Paha Co.   | 1,220           | 790             | -430                    | -35                       | 5.5                                    | 5.3                                    | -0.3  | -4                         | 0                                     |
| Kimball Co.     | 5,117           | 3,568           | -1,549                  | -30                       | 9.4                                    | 11.2                                   | 2.8   | 19                         | 0                                     |
| Knox Co.        | 11,197          | 8,439           | -2,758                  | -25                       | 15.1                                   | 15.5                                   | 0.6   | 3                          | 0                                     |
| Lancaster Co.   | 197,469         | 313,772         | 116,303                 | 59                        | 74.0                                   | 96.5                                   | 35.2  | 30                         | 100                                   |
| Lincoln Co.     | 34,846          | 35,265          | 419                     | 1                         | 28.7                                   | 31.8                                   | 4.8   | 11                         | 12                                    |
| Logan Co.       | 971             | 765             | -206                    | -21                       | 2.8                                    | 2.7                                    | -0.2  | -4                         | 0                                     |
| Loup Co.        | 813             | 604             | -209                    | -26                       | 2.4                                    | 2.5                                    | 0.2   | 4                          | 0                                     |
| McPherson Co.   | 606             | 493             | -113                    | -19                       | 3.8                                    | 3.9                                    | 0.2   | 3                          | 0                                     |

| Nebraska County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Madison Co.     | 31,351          | 35,132          | 3,781                   | 12                        | 21.8                                   | 24.7                                   | 4.5   | 13                         | 91                                    |
| Merrick Co.     | 8,947           | 7,859           | -1,088                  | -12                       | 9.4                                    | 8.5                                    | -1.4  | -10                        | 0                                     |
| Morrill Co.     | 6,038           | 4,796           | -1,242                  | -21                       | 11.5                                   | 12.0                                   | 0.8   | 4                          | 0                                     |
| Nance Co.       | 4,637           | 3,561           | -1,076                  | -23                       | 7.4                                    | 7.6                                    | 0.3   | 3                          | 0                                     |
| Nemaha Co.      | 8,264           | 6,957           | -1,307                  | -16                       | 6.8                                    | 7.4                                    | 0.9   | 9                          | 0                                     |
| Nuckolls Co.    | 6,648           | 4,269           | -2,379                  | -36                       | 12.0                                   | 12.8                                   | 1.3   | 7                          | 0                                     |
| Otoe Co.        | 15,009          | 15,956          | 947                     | 6                         | 16.4                                   | 19.9                                   | 5.5   | 21                         | 32                                    |
| Pawnee Co.      | 3,766           | 2,621           | -1,145                  | -30                       | 7.6                                    | 7.5                                    | -0.2  | -1                         | 0                                     |
| Perkins Co.     | 3,637           | 2,886           | -751                    | -21                       | 10.4                                   | 11.5                                   | 1.7   | 11                         | 0                                     |
| Phelps Co.      | 10,122          | 9,050           | -1,072                  | -11                       | 9.1                                    | 9.5                                    | 0.6   | 4                          | 0                                     |
| Pierce Co.      | 8,411           | 7,093           | -1,318                  | -16                       | 8.3                                    | 9.7                                    | 2.2   | 17                         | 0                                     |
| Platte Co.      | 29,130          | 33,231          | 4,101                   | 14                        | 17.4                                   | 22.2                                   | 7.5   | 28                         | 54                                    |

| Nebraska County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Polk Co.         | 6,132           | 5,309           | -823                    | -13                       | 8.6                                    | 9.4                                    | 1.3   | 9                          | 0                                     |
| Red Willow Co.   | 12,761          | 10,760          | -2,001                  | -16                       | 13.4                                   | 14.4                                   | 1.6   | 7                          | 0                                     |
| Richardson Co.   | 11,212          | 7,971           | -3,241                  | -29                       | 11.0                                   | 13.2                                   | 3.4   | 20                         | 0                                     |
| Rock Co.         | 2,436           | 1,420           | -1,016                  | -42                       | 4.7                                    | 5.0                                    | 0.5   | 6                          | 0                                     |
| Saline Co.       | 13,331          | 14,365          | 1,034                   | 8                         | 13.7                                   | 14.8                                   | 1.7   | 8                          | 97                                    |
| Sarpy Co.        | 90,724          | 181,376         | 90,652                  | 100                       | 21.0                                   | 40.3                                   | 30.2  | 92                         | 100                                   |
| Saunders Co.     | 18,553          | 21,032          | 2,479                   | 13                        | 17.0                                   | 18.5                                   | 2.3   | 9                          | 100                                   |
| Scotts Bluff Co. | 38,477          | 36,160          | -2,317                  | -6                        | 20.5                                   | 24.1                                   | 5.6   | 18                         | 0                                     |
| Seward Co.       | 15,370          | 17,203          | 1,833                   | 12                        | 8.1                                    | 8.7                                    | 0.9   | 7                          | 100                                   |
| Sheridan Co.     | 7,641           | 5,268           | -2,373                  | -31                       | 18.8                                   | 18.8                                   | 0.0   | 0                          | 0                                     |
| Sherman Co.      | 4,119           | 3,074           | -1,045                  | -25                       | 6.1                                    | 5.8                                    | -0.5  | -5                         |                                       |
| Sioux Co.        | 1,878           | 1,195           | -683                    | -36                       | 7.6                                    | 7.9                                    | 0.5   | 4                          | 0                                     |

| Nebraska County | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Stanton Co.     | 6,490            | 5,974            | -516                    | -8                        | 6.6                                    | 8.1                                    | 2.3   | 23                         | 0                                     |
| Thayer Co.      | 7,590            | 5,034            | -2,556                  | -34                       | 10.2                                   | 11.4                                   | 1.9   | 12                         | 0                                     |
| Thomas Co.      | 961              | 722              | -239                    | -25                       | 3.8                                    | 4.2                                    | 0.6   | 11                         | 0                                     |
| Thurston Co.    | 7,189            | 7,196            | 7                       | 0                         | 5.9                                    | 5.8                                    | -0.2  | -2                         | 0                                     |
| Valley Co.      | 5,686            | 4,227            | -1,459                  | -26                       | 8.6                                    | 8.7                                    | 0.2   | 1                          | 0                                     |
| Washington Co.  | 15,768           | 20,328           | 4,560                   | 29                        | 9.4                                    | 11.8                                   | 3.8   | 26                         | 100                                   |
| Wayne Co.       | 9,756            | 9,213            | -543                    | -6                        | 5.8                                    | 5.9                                    | 0.2   | 2                          | 0                                     |
| Webster Co.     | 4,806            | 3,505            | -1,301                  | -27                       | 9.0                                    | 9.2                                    | 0.3   | 2                          | 0                                     |
| Wheeler Co.     | 1,096            | 815              | -281                    | -26                       | 4.7                                    | 5.0                                    | 0.5   | 6                          | 0                                     |
| York Co.        | 14,951           | 13,762           | -1,189                  | -8                        | 13.0                                   | 13.8                                   | 1.3   | 6                          | 0                                     |
| <b>Totals</b>   | <b>1,581,776</b> | <b>1,915,947</b> | <b>334,171</b>          | <b>21</b>                 | <b>1,094.9</b>                         | <b>1,267.8</b>                         | <b>270.2</b>                                      | <b>16</b>                  | <b>100</b>                            |

| Nebraska County         | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Weighted Average</b> |                 |                 |                         |                           |  |  |   |                            | <b>60</b>                             |



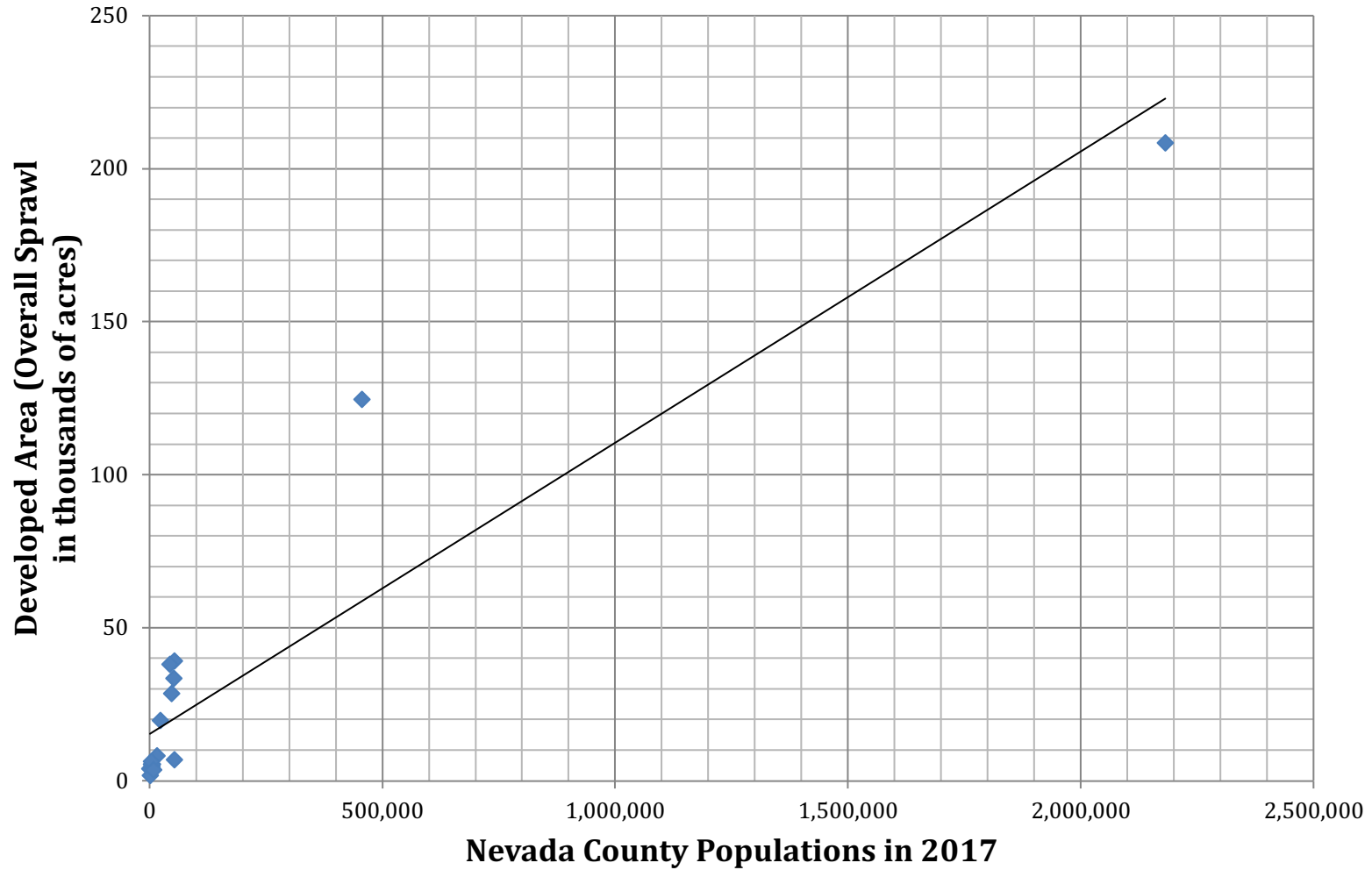
**Scatter Plot for Nebraska County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.94**

**Nevada**

| <b>Nevada County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Churchill Co.        | 14,178                 | 24,021                 | 9,843                          | 69                               | 10.2  | 19.8  | 15.0   | 94                                | 79   |
| Clark Co.            | 513,708                | 2,181,635              | 1,667,927                      | 325                              | 80.6  | 208.5   | 199.8  | 159                               | 100  |
| Douglas Co.          | 20,348                 | 48,030                 | 27,682                         | 136                              | 14.0  | 28.6  | 22.8   | 104                               | 100  |
| Elko Co.             | 19,687                 | 52,357                 | 32,670                         | 166                              | 26.4  | 33.5  | 11.1   | 27                                | 100  |
| Esmeralda Co.        | 1,213                  | 843                    | -370                           | -31                              | 2.2   | 4.0   | 2.8  | 82                                | 0  |
| Eureka Co.           | 1,350                  | 1,946                  | 596                            | 44                               | 1.8   | 1.9   | 0.2  | 6                                 | 100  |
| Humboldt Co.         | 11,220                 | 16,719                 | 5,499                          | 49                               | 4.6   | 8.2   | 5.6  | 78                                | 69   |
| Lander Co.           | 4,871                  | 5,579                  | 708                            | 15                               | 4.1   | 5.0   | 1.4  | 22                                | 68   |
| Lincoln Co.          | 3,753                  | 5,191                  | 1,438                          | 38                               | 2.5   | 4.5   | 3.1  | 80                                | 55   |
| Lyon Co.             | 14,901                 | 53,895                 | 38,994                         | 262                              | 9.1   | 39.2  | 47.0   | 331                               | 88   |
| Mineral Co.          | 6,125                  | 4,455                  | -1,670                         | -27                              | 3.9   | 5.5   | 2.5  | 41                                | 0  |

| <b>Nevada County</b>    | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Nye Co.                 | 13,090                 | 43,977                 | 30,887                         | 236                              | 12.3  | 38.1  | 40.3   | 210                               | 100  |
| Pershing Co.            | 3,683                  | 6,469                  | 2,786                          | 76                               | 5.2   | 5.6   | 0.6  | 8                                 | 100  |
| Storey Co.              | 1,786                  | 3,976                  | 2,190                          | 123                              | 1.9   | 6.5   | 7.2  | 242                               | 65   |
| Washoe Co.              | 208,577                | 456,629                | 248,052                        | 119                              | 29.6  | 124.6   | 148.4  | 321                               | 55   |
| White Pine Co.          | 8,724                  | 9,651                  | 927                            | 11                               | 2.4   | 3.6   | 1.9  | 50                                | 25   |
| Carson City             | 34,324                 | 54,532                 | 20,208                         | 59                               | 4.4   | 6.9   | 3.9  | 57                                | 100  |
| <b>Totals</b>           | <b>881,538</b>         | <b>2,969,905</b>       | <b>2,088,367</b>               | <b>237</b>                       | <b>215.2</b>                                  | <b>544.0</b>                                  | <b>513.8</b>   | <b>153</b>                        | <b>100</b>                                   |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>83</b>                                    |



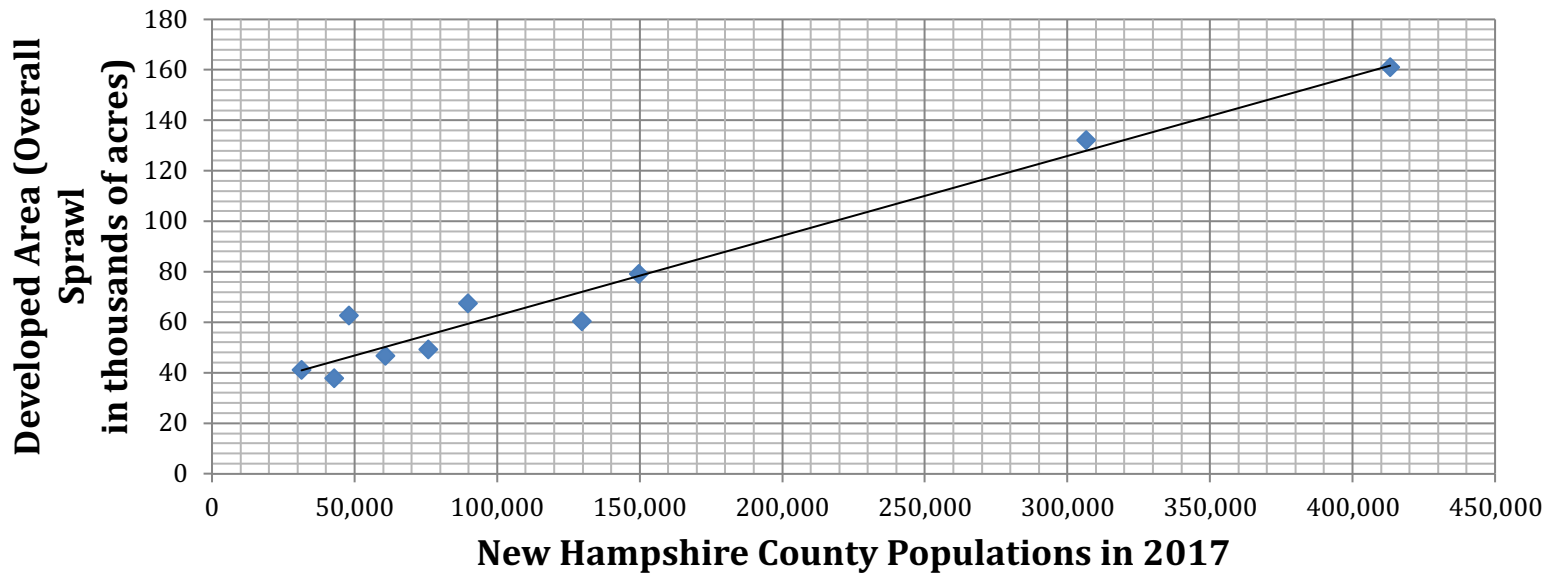
**Scatter Plot for Nevada County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.93**

## New Hampshire

| New Hampshire County | 1982 Population | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------------|-----------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Belknap Co.          | 43,619          | 60,872           | 17,253                  | 40                        | 30.0                                   | 46.6                                   | 25.9  | 55                         | 76                                    |
| Carroll Co.          | 28,354          | 48,132           | 19,778                  | 70                        | 36.8                                   | 62.6                                   | 40.3  | 70                         | 100                                   |
| Cheshire Co.         | 63,056          | 75,963           | 12,907                  | 20                        | 25.7                                   | 49.2                                   | 36.7  | 91                         | 29                                    |
| Coos Co.             | 34,394          | 31,396           | -2,998                  | -9                        | 29.5                                   | 41.1                                   | 18.1  | 39                         | 0                                     |
| Grafton Co.          | 66,810          | 89,853           | 23,043                  | 34                        | 41.6                                   | 67.5                                   | 40.5  | 62                         | 61                                    |
| Hillsborough Co.     | 287,334         | 413,204          | 125,870                 | 44                        | 85.2                                   | 160.9                                  | 118.3   | 89                         | 57                                    |
| Merrimack Co.        | 100,090         | 149,830          | 49,740                  | 50                        | 42.7                                   | 79.0                                   | 56.7  | 85                         | 66                                    |
| Rockingham Co.       | 197,574         | 306,669          | 109,095                 | 55                        | 64.6                                   | 132.2                                  | 105.6   | 105                        | 61                                    |
| Strafford Co.        | 89,422          | 129,841          | 40,419                  | 45                        | 27.1                                   | 60.3                                   | 51.9  | 123                        | 47                                    |
| Sullivan Co.         | 37,067          | 43,027           | 5,960                   | 16                        | 18.4                                   | 37.9                                   | 30.5  | 106                        | 21                                    |
| <b>Totals</b>        | <b>947,720</b>  | <b>1,348,787</b> | <b>401,067</b>          | <b>42</b>                 | <b>401.6</b>                           | <b>737.3</b>                           | <b>524.5</b>                                      | <b>84</b>                  | <b>58</b>                             |

| New Hampshire County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Weighted Average     |                 |                 |                         |                           |  |  |   |                            | 56                                    |



**Scatter Plot for New Hampshire County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

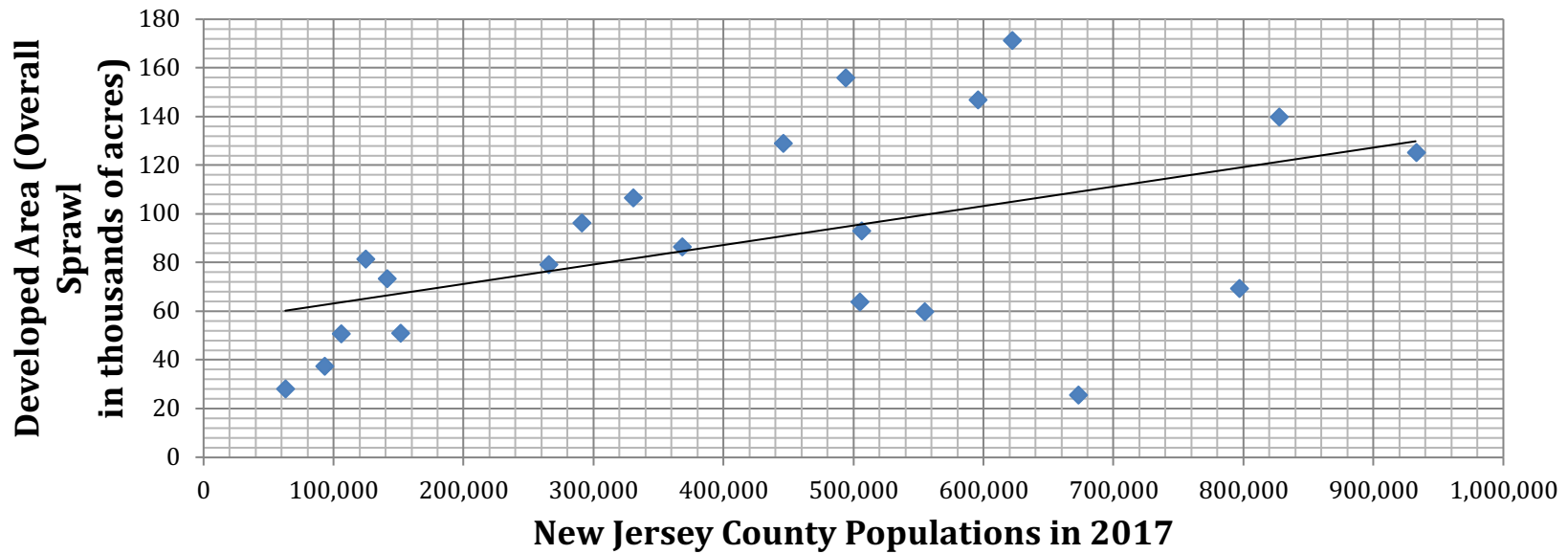
**R-value: 0.98**

**New Jersey**

| <b>New Jersey County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Atlantic Co.             | 196,548                | 265,498                | 68,950                         | 35                               | 39.1  | 79.3  | 62.8   | 103                               | 43   |
| Bergen Co.               | 844,419                | 932,420                | 88,001                         | 10                               | 114.3   | 125.3   | 17.2   | 10                                | 100  |
| Burlington Co.           | 370,609                | 445,610                | 75,001                         | 20                               | 73.8  | 129.1   | 86.4   | 75                                | 33   |
| Camden Co.               | 479,026                | 506,224                | 27,198                         | 6                                | 64.7  | 93.0  | 44.2   | 44                                | 15   |
| Cape May Co.             | 85,104                 | 93,129                 | 8,025                          | 9                                | 20.9  | 37.6  | 26.1   | 80                                | 15   |
| Cumberland Co.           | 133,494                | 151,423                | 17,929                         | 13                               | 23.1  | 51.1  | 43.8   | 121                               | 16   |
| Essex Co.                | 831,087                | 796,349                | -34,738                        | -4                               | 64.1  | 69.5  | 8.4  | 8                                 | 0  |
| Gloucester Co.           | 204,856                | 290,961                | 86,105                         | 42                               | 49.2  | 96.3  | 73.6   | 96                                | 52   |
| Hudson Co.               | 564,825                | 672,826                | 108,001                        | 19                               | 23.7  | 25.7  | 3.1  | 8                                 | 100  |
| Hunterdon Co.            | 89,971                 | 124,712                | 34,741                         | 39                               | 36.7  | 81.5  | 70.0   | 122                               | 41   |
| Mercer Co.               | 307,882                | 368,168                | 60,286                         | 20                               | 54.2  | 86.6  | 50.6   | 60                                | 38   |

| New Jersey County | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Middlesex Co.     | 606,421          | 827,363          | 220,942                 | 36                        | 96.7                                   | 139.8                                  | 67.3  | 45                         | 84                                    |
| Monmouth Co.      | 510,213          | 621,990          | 111,777                 | 22                        | 91.8                                   | 171.4                                  | 124.4   | 87                         | 32                                    |
| Morris Co.        | 412,302          | 493,920          | 81,618                  | 20                        | 97.3                                   | 155.9                                  | 91.6  | 60                         | 38                                    |
| Ocean Co.         | 361,059          | 595,424          | 234,365                 | 65                        | 84.4                                   | 146.9                                  | 97.7  | 74                         | 90                                    |
| Passaic Co.       | 452,673          | 504,402          | 51,729                  | 11                        | 49.0                                   | 63.8                                   | 23.1  | 30                         | 41                                    |
| Salem Co.         | 64,892           | 62,883           | -2,009                  | -3                        | 16.3                                   | 28.2                                   | 18.6  | 73                         | 0                                     |
| Somerset Co.      | 206,893          | 330,573          | 123,680                 | 60                        | 64.4                                   | 106.6                                  | 65.9  | 66                         | 93                                    |
| Sussex Co.        | 119,029          | 141,197          | 22,168                  | 19                        | 37.1                                   | 73.5                                   | 56.9  | 98                         | 25                                    |
| Union Co.         | 504,380          | 554,738          | 50,358                  | 10                        | 56.1                                   | 59.9                                   | 5.9   | 7                          | 100                                   |
| Warren Co.        | 85,287           | 105,715          | 20,428                  | 24                        | 25.8                                   | 50.8                                   | 39.1  | 97                         | 32                                    |
| <b>Totals</b>     | <b>7,430,970</b> | <b>8,885,525</b> | <b>1,454,555</b>        | <b>20</b>                 | <b>1,182.7</b>                         | <b>1,871.8</b>                         | <b>1,076.7</b>                                    | <b>58</b>                  | <b>39</b>                             |

| New Jersey County       | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Weighted Average</b> |                 |                 |                         |                           |  |  |   |                            | <b>47</b>                             |



**Scatter Plot for New Jersey County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.49**

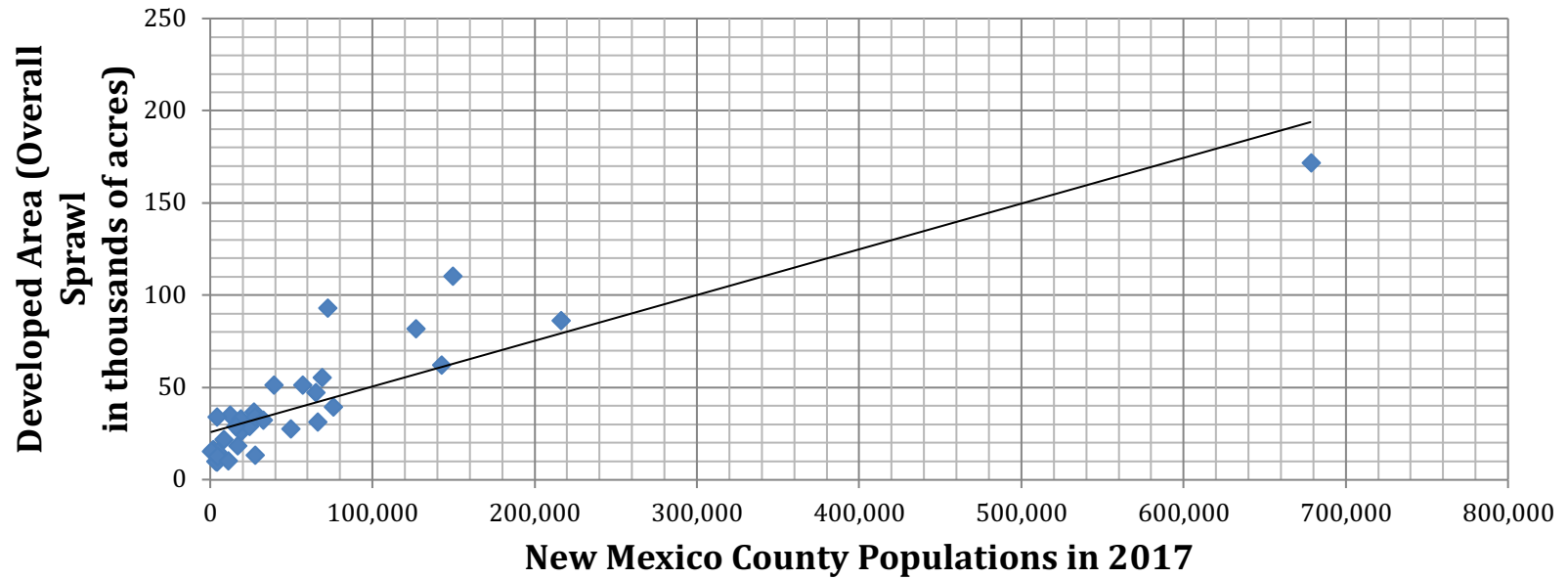
**New Mexico**

| <b>New Mexico County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Bernalillo Co.           | 433,469                | 678,203                | 244,734                        | 56                               | 78.6  | 171.7   | 145.5  | 118                               | 57   |
| Catron Co.               | 2,666                  | 3,553                  | 887                            | 33                               | 7.9   | 10.2  | 3.6  | 29                                | 100  |
| Chaves Co.               | 53,647                 | 65,080                 | 11,433                         | 21                               | 31.5  | 47.4  | 24.8   | 50                                | 47   |
| Cibola Co.               | 28,211                 | 26,921                 | -1,290                         | -5                               | 21.7  | 36.9  | 23.8   | 70                                | 0  |
| Colfax Co.               | 14,153                 | 12,151                 | -2,002                         | -14                              | 15.2  | 35.2  | 31.3   | 132                               | 0  |
| Curry Co.                | 41,970                 | 49,794                 | 7,824                          | 19                               | 17.0  | 27.8  | 16.9   | 64                                | 35   |
| DeBaca Co.               | 2,426                  | 1,805                  | -621                           | -26                              | 14.1  | 16.4  | 3.6  | 16                                | 0  |
| Dona Ana Co.             | 103,448                | 216,174                | 112,726                        | 109                              | 21.1  | 86.2  | 101.7  | 309                               | 52   |
| Eddy Co.                 | 52,233                 | 57,108                 | 4,875                          | 9                                | 24.5  | 51.3  | 41.9   | 109                               | 12   |
| Grant Co.                | 27,969                 | 27,642                 | -327                           | -1                               | 14.3  | 13.4  | -1.4   | -6                                | 18   |
| Guadalupe Co.            | 4,290                  | 4,410                  | 120                            | 3                                | 11.8  | 15.1  | 5.2  | 28                                | 11   |

| <b>New Mexico County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Harding Co.              | 1,016                  | 684                    | -332                           | -33                              | 12.8  | 15.3  | 3.9  | 20                                | 0  |
| Hidalgo Co.              | 6,332                  | 4,298                  | -2,034                         | -32                              | 9.3   | 9.6   | 0.5  | 3                                 | 0  |
| Lea Co.                  | 64,227                 | 69,046                 | 4,819                          | 8                                | 43.8  | 55.6  | 18.4   | 27                                | 30   |
| Lincoln Co.              | 11,667                 | 19,468                 | 7,801                          | 67                               | 22.2  | 26.6  | 6.9  | 20                                | 100  |
| Los Alamos               | 17,795                 | 18,742                 | 947                            | 5                                | 21.7  | 26.3  | 7.2  | 21                                | 27   |
| Luna Co.                 | 16,193                 | 24,100                 | 7,907                          | 49                               | 19.7  | 29.1  | 14.7   | 48                                | 100  |
| McKinley Co.             | 56,880                 | 72,423                 | 15,543                         | 27                               | 22.9  | 93.2  | 109.8  | 307                               | 17   |
| Mora Co.                 | 4,252                  | 4,530                  | 278                            | 7                                | 9.5   | 12.7  | 5.0  | 34                                | 22   |
| Otero Co.                | 46,036                 | 66,121                 | 20,085                         | 44                               | 10.9  | 31.3  | 31.9   | 187                               | 34   |
| Quay Co.                 | 10,643                 | 8,299                  | -2,344                         | -22                              | 19.4  | 21.8  | 3.8  | 12                                | 0  |
| Rio Arriba Co.           | 30,078                 | 39,235                 | 9,157                          | 30                               | 32.8  | 51.3  | 28.9   | 56                                | 59   |
| Roosevelt Co.            | 16,061                 | 18,900                 | 2,839                          | 18                               | 24.8  | 33.1  | 13.0   | 33                                | 56   |

| New Mexico County | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Sandoval Co.      | 37,418           | 142,689          | 105,271                 | 281                       | 21.8                                   | 62.3                                   | 63.3  | 186                        | 100                                   |
| San Juan Co.      | 88,833           | 126,917          | 38,084                  | 43                        | 44.4                                   | 81.8                                   | 58.4  | 84                         | 58                                    |
| San Miguel Co.    | 23,186           | 27,715           | 4,529                   | 20                        | 27.8                                   | 34.1                                   | 9.8   | 23                         | 87                                    |
| Santa Fe Co.      | 80,118           | 149,491          | 69,373                  | 87                        | 26.0                                   | 110.3                                  | 131.7   | 324                        | 43                                    |
| Sierra Co.        | 8,942            | 11,064           | 2,122                   | 24                        | 8.4                                    | 10.4                                   | 3.1   | 24                         | 100                                   |
| Socorro Co.       | 13,508           | 16,832           | 3,324                   | 25                        | 14.9                                   | 18.6                                   | 5.8   | 25                         | 99                                    |
| Taos Co.          | 20,654           | 32,790           | 12,136                  | 59                        | 9.7                                    | 32.5                                   | 35.6  | 235                        | 38                                    |
| Torrance Co.      | 7,883            | 15,535           | 7,652                   | 97                        | 19.3                                   | 29.0                                   | 15.2  | 50                         | 100                                   |
| Union Co.         | 5,219            | 4,180            | -1,039                  | -20                       | 21.6                                   | 34.0                                   | 19.4  | 57                         | 0                                     |
| Valencia Co.      | 32,399           | 75,884           | 43,485                  | 134                       | 16.8                                   | 39.6                                   | 35.6  | 136                        | 99                                    |
| <b>Totals</b>     | <b>1,363,822</b> | <b>2,091,784</b> | <b>727,962</b>          | <b>53</b>                 | <b>718.2</b>                           | <b>1,370.1</b>                         | <b>1,018.6</b>                                    | <b>91</b>                  | <b>66</b>                             |

| New Mexico County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Weighted Average  |                 |                 |                         |                           |  |  |   |                            | 47                                    |



**Scatter Plot for New Mexico County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.88**

## New York

| New York County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Albany Co.      | 287,159         | 307,717         | 20,558                  | 7                         | 72.0                                   | 93.0                                   | 32.8  | 29                         | 27                                    |
| Allegany Co.    | 51,640          | 46,639          | -5,001                  | -10                       | 24.3                                   | 31.9                                   | 11.9  | 31                         | 0                                     |
| Bronx Co.       | 1,164,329       | 1,440,625       | 276,296                 | 24                        | 28.3                                   | 29.2                                   | 1.4   | 3                          | 100                                   |
| Broome Co.      | 213,903         | 193,100         | -20,803                 | -10                       | 45.9                                   | 68.2                                   | 34.8  | 49                         | 0                                     |
| Cattaraugus Co. | 85,877          | 77,176          | -8,701                  | -10                       | 36.7                                   | 48.8                                   | 18.9  | 33                         | 0                                     |
| Cayuga Co.      | 80,020          | 77,457          | -2,563                  | -3                        | 29.6                                   | 41.1                                   | 18.0  | 39                         | 0                                     |
| Chautauqua Co.  | 146,333         | 128,372         | -17,961                 | -12                       | 46.4                                   | 60.0                                   | 21.3  | 29                         | 0                                     |
| Chemung Co.     | 96,032          | 84,736          | -11,296                 | -12                       | 21.8                                   | 31.0                                   | 14.4  | 42                         | 0                                     |
| Chenango Co.    | 49,737          | 47,805          | -1,932                  | -4                        | 24.9                                   | 32.4                                   | 11.7  | 30                         | 0                                     |
| Clinton Co.     | 81,202          | 80,531          | -671                    | -1                        | 28.1                                   | 43.3                                   | 23.8  | 54                         | 0                                     |
| Columbia Co.    | 60,339          | 60,338          | -1                      | 0                         | 22.7                                   | 35.8                                   | 20.5  | 58                         | 0                                     |

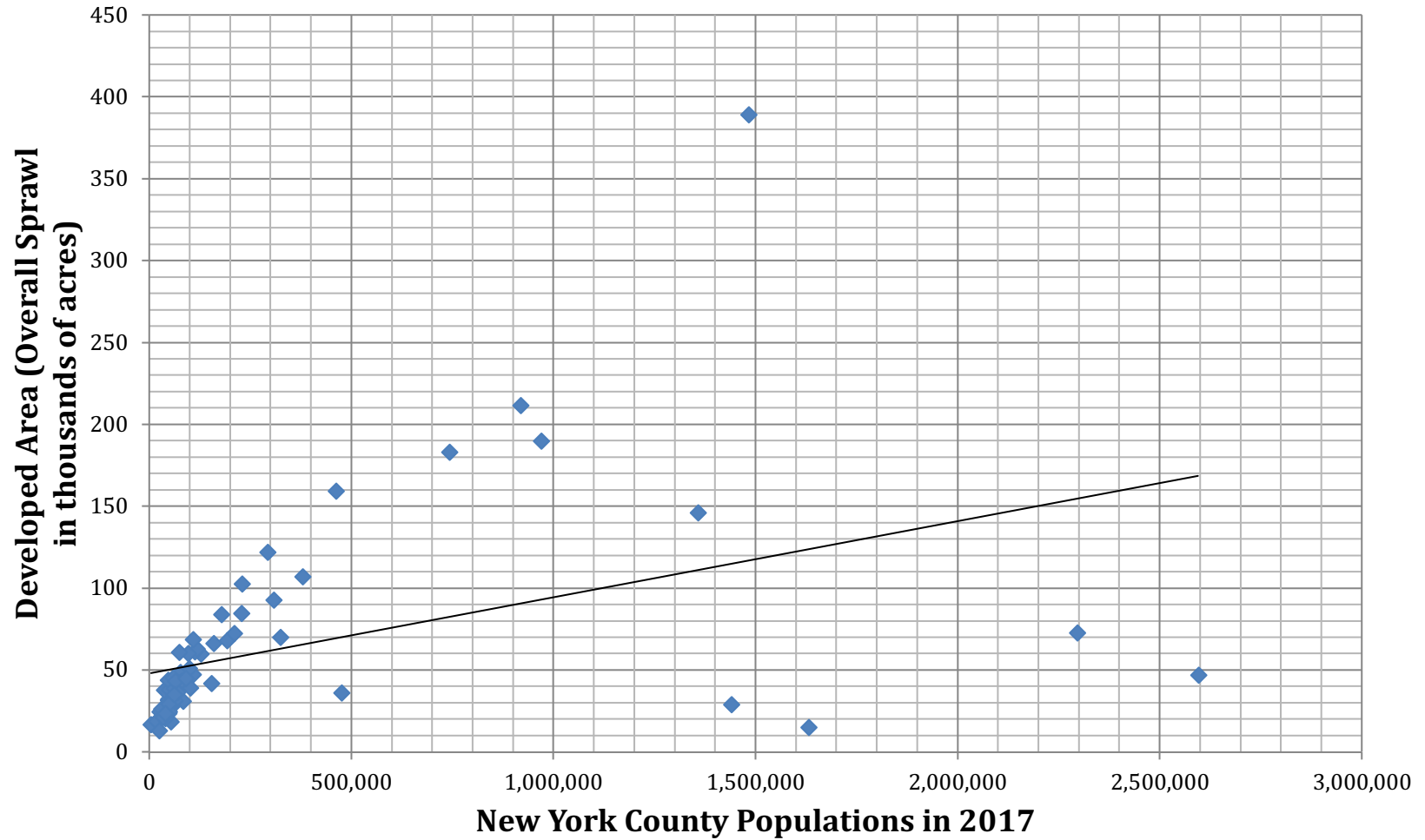
| New York County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Cortland Co.    | 48,442          | 47,815          | -627                    | -1                        | 15.3                                   | 23.6                                   | 13.0  | 54                         | 0                                     |
| Delaware Co.    | 46,493          | 45,028          | -1,465                  | -3                        | 22.7                                   | 36.5                                   | 21.6  | 61                         | 0                                     |
| Dutchess Co.    | 246,676         | 293,545         | 46,869                  | 19                        | 92.6                                   | 122.1                                  | 46.1  | 32                         | 63                                    |
| Erie Co.        | 1,000,862       | 919,034         | -81,828                 | -8                        | 163.1                                  | 211.7                                  | 75.9  | 30                         | 0                                     |
| Essex Co.       | 36,492          | 37,487          | 995                     | 3                         | 30.6                                   | 37.9                                   | 11.4  | 24                         | 13                                    |
| Franklin Co.    | 44,038          | 50,465          | 6,427                   | 15                        | 23.4                                   | 38.4                                   | 23.4  | 64                         | 28                                    |
| Fulton Co.      | 54,986          | 53,802          | -1,184                  | -2                        | 11.6                                   | 18.5                                   | 10.8  | 59                         | 0                                     |
| Genesee Co.     | 59,743          | 57,798          | -1,945                  | -3                        | 17.6                                   | 28.5                                   | 17.0  | 62                         | 0                                     |
| Greene Co.      | 40,993          | 47,442          | 6,449                   | 16                        | 30.6                                   | 43.9                                   | 20.8  | 43                         | 40                                    |
| Hamilton Co.    | 4,982           | 4,471           | -511                    | -10                       | 13.4                                   | 16.9                                   | 5.5   | 26                         | 0                                     |
| Herkimer Co.    | 66,436          | 62,163          | -4,273                  | -6                        | 25.9                                   | 39.0                                   | 20.5  | 51                         | 0                                     |
| Jefferson Co.   | 87,302          | 113,157         | 25,855                  | 30                        | 41.6                                   | 61.2                                   | 30.6  | 47                         | 67                                    |

| <b>New York County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Kings Co.              | 2,251,785              | 2,594,676              | 342,891                        | 15                               | 44.9  | 47.2  | 3.6  | 5                                 | 100  |
| Lewis Co.              | 24,747                 | 26,605                 | 1,858                          | 8                                | 19.5  | 24.8  | 8.3  | 27                                | 30   |
| Livingston Co.         | 57,826                 | 63,483                 | 5,657                          | 10                               | 20.9  | 31.4  | 16.4   | 50                                | 23   |
| Madison Co.            | 65,263                 | 70,942                 | 5,679                          | 9                                | 26.8  | 36.6  | 15.3   | 37                                | 27   |
| Monroe Co.             | 710,131                | 742,724                | 32,593                         | 5                                | 146.9   | 183.1   | 56.6   | 25                                | 20   |
| Montgomery Co.         | 53,066                 | 49,163                 | -3,903                         | -7                               | 17.3  | 24.6  | 11.4   | 42                                | 0  |
| Nassau Co.             | 1,314,841              | 1,357,293              | 42,452                         | 3                                | 122.8   | 146.1   | 36.4   | 19                                | 18   |
| New York Co.           | 1,422,332              | 1,630,698              | 208,366                        | 15                               | 14.6  | 15.1  | 0.8  | 3                                 | 100  |
| Niagara Co.            | 222,717                | 210,848                | -11,869                        | -5                               | 53.5  | 72.4  | 29.5   | 35                                | 0  |
| Oneida Co.             | 253,352                | 230,011                | -23,341                        | -9                               | 62.1  | 102.7   | 63.4   | 65                                | 0  |
| Onondaga Co.           | 461,697                | 461,795                | 98                             | 0                                | 105.2   | 159.5   | 84.8   | 52                                | 0  |
| Ontario Co.            | 90,011                 | 109,538                | 19,527                         | 22                               | 31.0  | 47.5  | 25.8   | 53                                | 46   |

| New York County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Orange Co.       | 267,075         | 379,758         | 112,683                 | 42                        | 60.5                                   | 107.1                                  | 72.8  | 77                         | 62                                    |
| Orleans Co.      | 38,768          | 40,786          | 2,018                   | 5                         | 17.2                                   | 20.6                                   | 5.3   | 20                         | 28                                    |
| Oswego Co.       | 113,482         | 118,427         | 4,945                   | 4                         | 34.8                                   | 63.1                                   | 44.2  | 81                         | 7                                     |
| Otsego Co.       | 58,870          | 59,920          | 1,050                   | 2                         | 28.0                                   | 45.4                                   | 27.2  | 62                         | 4                                     |
| Putnam Co.       | 78,442          | 98,856          | 20,414                  | 26                        | 36.5                                   | 51.1                                   | 22.8  | 40                         | 69                                    |
| Queens Co.       | 1,911,597       | 2,295,808       | 384,211                 | 20                        | 71.8                                   | 72.9                                   | 1.7   | 2                          | 100                                   |
| Rensselaer Co.   | 151,806         | 159,200         | 7,394                   | 5                         | 46.6                                   | 66.6                                   | 31.3  | 43                         | 13                                    |
| Richmond Co.     | 359,062         | 475,671         | 116,609                 | 32                        | 30.1                                   | 36.2                                   | 9.5   | 20                         | 100                                   |
| Rockland Co.     | 260,232         | 324,622         | 64,390                  | 25                        | 57.2                                   | 70.2                                   | 20.3  | 23                         | 100                                   |
| St. Lawrence Co. | 112,660         | 108,699         | -3,961                  | -4                        | 48.1                                   | 68.7                                   | 32.2  | 43                         | 0                                     |
| Saratoga Co.     | 155,572         | 229,276         | 73,704                  | 47                        | 42.8                                   | 84.8                                   | 65.6  | 98                         | 57                                    |
| Schenectady Co.  | 149,414         | 154,710         | 5,296                   | 4                         | 32.0                                   | 42.1                                   | 15.8  | 32                         | 13                                    |

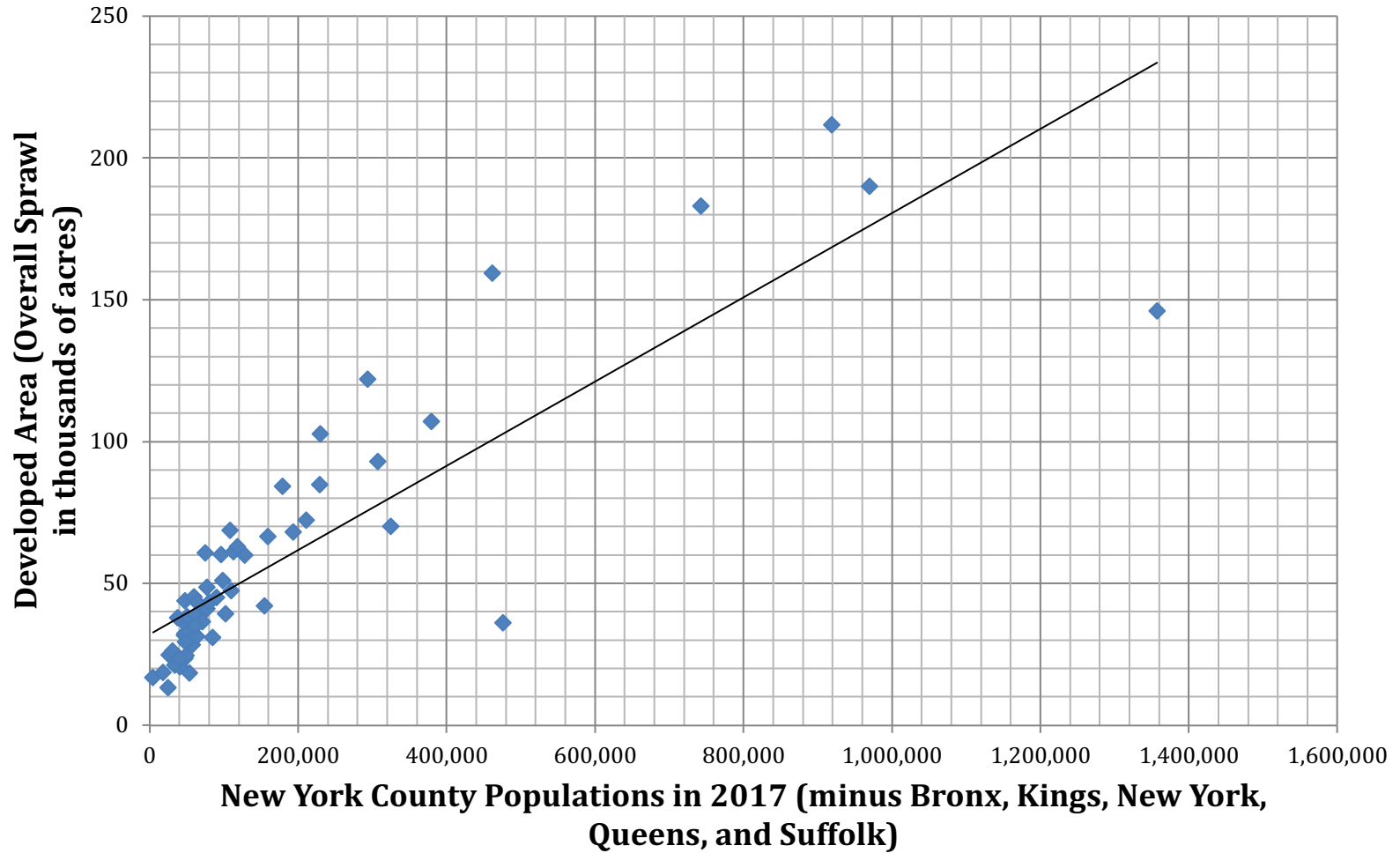
| <b>New York County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Schoharie Co.          | 29,727                 | 31,255                 | 1,528                          | 5                                | 19.2  | 26.3  | 11.1   | 37                                | 16   |
| Schuyler Co.           | 17,869                 | 17,913                 | 44                             | 0                                | 12.1  | 18.8  | 10.5   | 55                                | 0  |
| Seneca Co.             | 33,265                 | 34,246                 | 981                            | 3                                | 17.1  | 21.3  | 6.6  | 25                                | 13   |
| Steuben Co.            | 98,121                 | 96,360                 | -1,761                         | -2                               | 44.3  | 60.3  | 25.0   | 36                                | 0  |
| Suffolk Co.            | 1,288,825              | 1,483,358              | 194,533                        | 15                               | 288.7   | 389.3   | 157.2  | 35                                | 47   |
| Sullivan Co.           | 63,698                 | 74,994                 | 11,296                         | 18                               | 42.5  | 60.9  | 28.8   | 43                                | 45   |
| Tioga Co.              | 50,102                 | 48,609                 | -1,493                         | -3                               | 24.2  | 29.5  | 8.3  | 22                                | 0  |
| Tompkins Co.           | 88,458                 | 102,664                | 14,206                         | 16                               | 20.6  | 39.3  | 29.2   | 91                                | 23   |
| Ulster Co.             | 157,770                | 178,635                | 20,865                         | 13                               | 68.6  | 84.2  | 24.4   | 23                                | 61   |
| Warren Co.             | 55,031                 | 64,365                 | 9,334                          | 17                               | 30.7  | 43.4  | 19.8   | 41                                | 45   |
| Washington Co.         | 54,737                 | 61,559                 | 6,822                          | 12                               | 23.1  | 35.1  | 18.8   | 52                                | 28   |
| Wayne Co.              | 85,837                 | 90,429                 | 4,592                          | 5                                | 32.7  | 45.1  | 19.4   | 38                                | 16   |

| <b>New York County</b>  | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Westchester Co.         | 865,695                | 969,689                | 103,994                        | 12                               | 155.1   | 190.0   | 54.5   | 23                                | 56   |
| Wyoming Co.             | 40,436                 | 40,282                 | -154                           | 0                                | 16.6  | 23.7  | 11.1   | 43                                | 0  |
| Yates Co.               | 21,402                 | 25,002                 | 3,600                          | 17                               | 6.9   | 13.3  | 10.0   | 93                                | 24   |
| <b>Totals</b>           | <b>17,589,737</b>      | <b>19,589,572</b>      | <b>1,999,835</b>               | <b>11</b>                        | <b>2,842.6</b>                                | <b>3,893.2</b>                                | <b>1,641.6</b>   | <b>37</b>                         | <b>34</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>26</b>                                    |



**Scatter Plot for New York County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.42**



**Scatter Plot for New York County Populations versus Developed Land Area (Cumulative Sprawl) in 2017 (excluding Bronx, Kings, New York, Queens, and Suffolk counties)**

**R-value: 0.86**

**North Carolina**

| North Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Alamance Co.          | 101,000         | 163,276         | 62,276                  | 62                        | 43.6                                   | 67.2                                   | 36.9  | 54                         | 100                                   |
| Alexander Co.         | 25,572          | 37,143          | 11,571                  | 45                        | 9.6                                    | 27.7                                   | 28.3  | 189                        | 35                                    |
| Alleghany Co.         | 9,754           | 10,988          | 1,234                   | 13                        | 6.0                                    | 13.2                                   | 11.3  | 120                        | 15                                    |
| Anson Co.             | 25,317          | 24,829          | -488                    | -2                        | 14.0                                   | 25.4                                   | 17.8  | 81                         | 0                                     |
| Ashe Co.              | 22,496          | 26,787          | 4,291                   | 19                        | 16.1                                   | 31.1                                   | 23.4  | 93                         | 27                                    |
| Avery Co.             | 14,572          | 17,517          | 2,945                   | 20                        | 11.2                                   | 22.0                                   | 16.9  | 96                         | 27                                    |
| Beaufort Co.          | 41,613          | 47,033          | 5,420                   | 13                        | 29.1                                   | 46.3                                   | 26.9  | 59                         | 26                                    |
| Bertie Co.            | 21,048          | 19,263          | -1,785                  | -8                        | 8.2                                    | 15.6                                   | 11.6  | 90                         | 0                                     |
| Bladen Co.            | 30,147          | 33,443          | 3,296                   | 11                        | 8.2                                    | 18.8                                   | 16.6  | 129                        | 13                                    |
| Brunswick Co.         | 38,703          | 130,859         | 92,156                  | 238                       | 34.0                                   | 86.8                                   | 82.5  | 155                        | 100                                   |
| Buncombe Co.          | 163,693         | 257,071         | 93,378                  | 57                        | 45.0                                   | 119.3                                  | 116.1   | 165                        | 46                                    |

| North Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Burke Co.             | 73,583          | 90,157          | 16,574                  | 23                        | 52.2                                   | 70.9                                   | 29.2  | 36                         | 66                                    |
| Cabarrus Co.          | 89,158          | 206,988         | 117,830                 | 132                       | 38.1                                   | 72.8                                   | 54.2  | 91                         | 100                                   |
| Caldwell Co.          | 68,057          | 81,933          | 13,876                  | 20                        | 29.2                                   | 60.9                                   | 49.5  | 109                        | 25                                    |
| Camden Co.            | 5,675           | 10,532          | 4,857                   | 86                        | 3.0                                    | 6.6                                    | 5.6   | 120                        | 78                                    |
| Carteret Co.          | 43,762          | 68,921          | 25,159                  | 57                        | 24.4                                   | 52.4                                   | 43.8  | 115                        | 59                                    |
| Caswell Co.           | 21,416          | 22,616          | 1,200                   | 6                         | 6.3                                    | 16.7                                   | 16.3  | 165                        | 6                                     |
| Catawba Co.           | 107,754         | 157,852         | 50,098                  | 46                        | 67.7                                   | 102.2                                  | 53.9  | 51                         | 93                                    |
| Chatham Co.           | 34,430          | 71,189          | 36,759                  | 107                       | 24.0                                   | 53.0                                   | 45.3  | 121                        | 92                                    |
| Cherokee Co.          | 19,302          | 27,954          | 8,652                   | 45                        | 10.0                                   | 29.7                                   | 30.8  | 197                        | 34                                    |
| Chowan Co.            | 12,585          | 14,029          | 1,444                   | 11                        | 7.8                                    | 14.8                                   | 10.9  | 90                         | 17                                    |
| Clay Co.              | 6,878           | 11,004          | 4,126                   | 60                        | 5.2                                    | 10.8                                   | 8.8   | 108                        | 64                                    |
| Cleveland Co.         | 83,144          | 97,134          | 13,990                  | 17                        | 25.9                                   | 55.3                                   | 45.9  | 114                        | 21                                    |

| North Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Columbus Co.          | 50,859          | 56,047          | 5,188                   | 10                        | 31.5                                   | 50.1                                   | 29.1  | 59                         | 21                                    |
| Craven Co.            | 73,774          | 102,492         | 28,718                  | 39                        | 30.1                                   | 47.5                                   | 27.2  | 58                         | 72                                    |
| Cumberland Co.        | 251,394         | 330,994         | 79,600                  | 32                        | 49.3                                   | 106.9                                  | 90.0  | 117                        | 36                                    |
| Currituck Co.         | 11,537          | 26,290          | 14,753                  | 128                       | 8.6                                    | 23.8                                   | 23.8  | 177                        | 81                                    |
| Dare Co.              | 14,593          | 36,199          | 21,606                  | 148                       | 17.8                                   | 27.7                                   | 15.5  | 56                         | 100                                   |
| Davidson Co.          | 116,026         | 165,180         | 49,154                  | 42                        | 53.0                                   | 86.8                                   | 52.8  | 64                         | 72                                    |
| Davie Co.             | 25,316          | 42,308          | 16,992                  | 67                        | 11.6                                   | 23.8                                   | 19.1  | 105                        | 71                                    |
| Duplin Co.            | 40,638          | 58,943          | 18,305                  | 45                        | 17.4                                   | 35.4                                   | 28.1  | 103                        | 52                                    |
| Durham Co.            | 156,300         | 312,153         | 155,853                 | 100                       | 44.3                                   | 75.5                                   | 48.8  | 70                         | 100                                   |
| Edgecombe Co.         | 56,740          | 52,756          | -3,984                  | -7                        | 22.5                                   | 31.8                                   | 14.5  | 41                         | 0                                     |
| Forsyth Co.           | 249,154         | 375,840         | 126,686                 | 51                        | 59.4                                   | 108.2                                  | 76.3  | 82                         | 69                                    |
| Franklin Co.          | 30,769          | 66,155          | 35,386                  | 115                       | 11.2                                   | 45.5                                   | 53.6  | 306                        | 55                                    |

| North Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Gaston Co.            | 166,369         | 219,656         | 53,287                  | 32                        | 49.2                                   | 93.4                                   | 69.1  | 90                         | 43                                    |
| Gates Co.             | 8,936           | 11,514          | 2,578                   | 29                        | 4.3                                    | 9.5                                    | 8.1   | 121                        | 32                                    |
| Graham Co.            | 7,189           | 8,524           | 1,335                   | 19                        | 2.1                                    | 6.5                                    | 6.9   | 210                        | 15                                    |
| Granville Co.         | 34,790          | 59,372          | 24,582                  | 71                        | 9.0                                    | 30.4                                   | 33.4  | 238                        | 44                                    |
| Greene Co.            | 15,855          | 20,963          | 5,108                   | 32                        | 6.8                                    | 13.1                                   | 9.8   | 93                         | 43                                    |
| Guilford Co.          | 322,602         | 528,243         | 205,641                 | 64                        | 96.3                                   | 166.8                                  | 110.2   | 73                         | 90                                    |
| Halifax Co.           | 55,141          | 51,311          | -3,830                  | -7                        | 24.6                                   | 37.6                                   | 20.3  | 53                         | 0                                     |
| Harnett Co.           | 61,176          | 132,395         | 71,219                  | 116                       | 23.7                                   | 60.5                                   | 57.5  | 155                        | 82                                    |
| Haywood Co.           | 46,894          | 61,005          | 14,111                  | 30                        | 25.8                                   | 54.8                                   | 45.3  | 112                        | 35                                    |
| Henderson Co.         | 61,579          | 115,216         | 53,637                  | 87                        | 28.9                                   | 73.5                                   | 69.7  | 154                        | 67                                    |
| Hertford Co.          | 23,270          | 23,923          | 653                     | 3                         | 10.6                                   | 15.2                                   | 7.2   | 43                         | 8                                     |
| Hoke Co.              | 21,077          | 54,138          | 33,061                  | 157                       | 11.1                                   | 27.7                                   | 25.9  | 150                        | 100                                   |

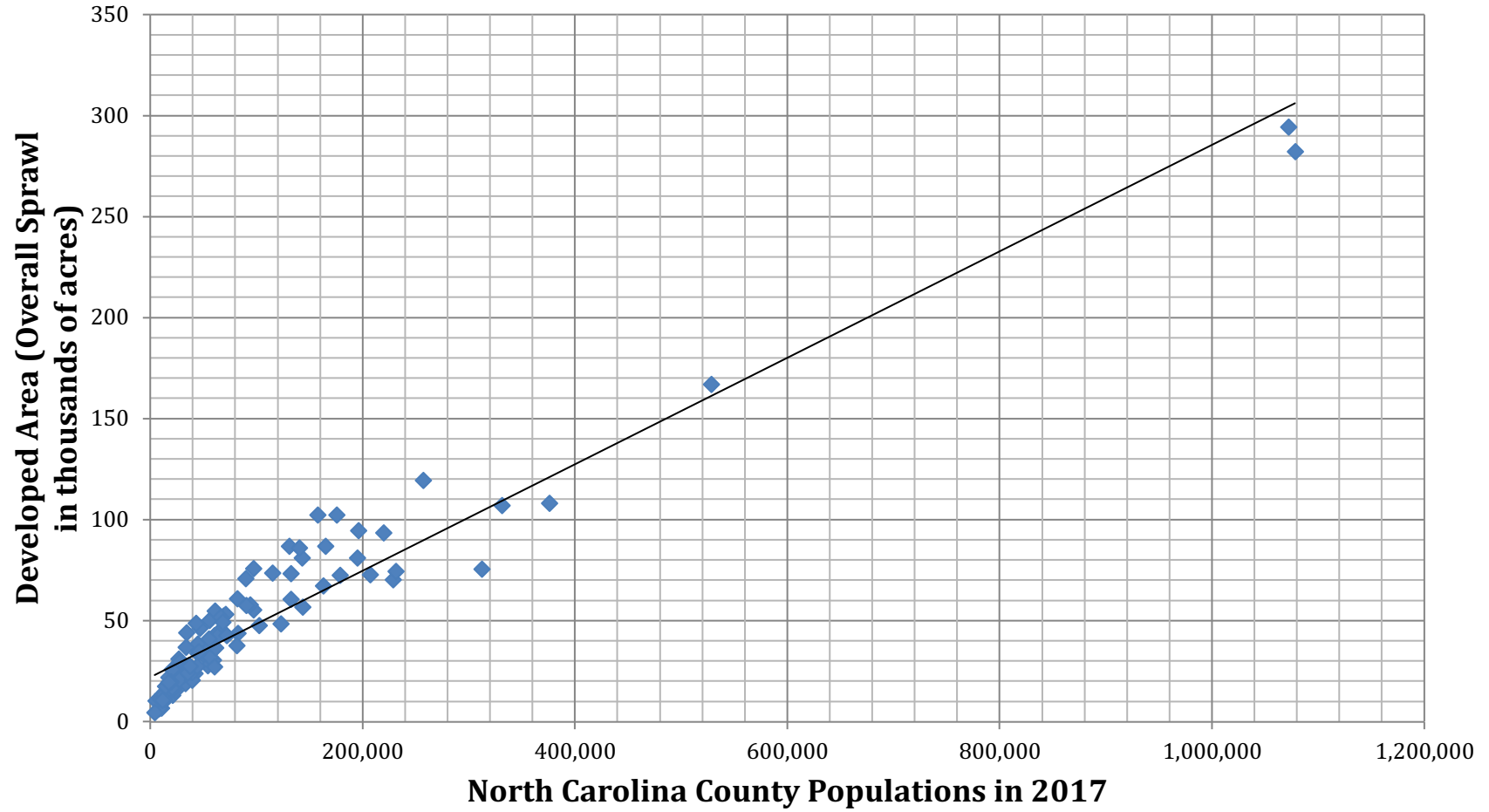
| North Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Hyde Co.              | 5,879           | 5,240           | -639                    | -11                       | 6.4                                    | 10.3                                   | 6.1   | 61                         | 0                                     |
| Iredell Co.           | 84,487          | 175,634         | 91,147                  | 108                       | 43.8                                   | 102.4                                  | 91.6  | 134                        | 86                                    |
| Jackson Co.           | 26,400          | 43,224          | 16,824                  | 64                        | 6.7                                    | 48.7                                   | 65.6  | 627                        | 25                                    |
| Johnston Co.          | 72,058          | 196,374         | 124,316                 | 173                       | 31.4                                   | 94.6                                   | 98.8  | 201                        | 91                                    |
| Jones Co.             | 9,712           | 9,573           | -139                    | -1                        | 8.2                                    | 11.2                                   | 4.7   | 37                         | 0                                     |
| Lee Co.               | 37,405          | 60,403          | 22,998                  | 61                        | 20.1                                   | 42.6                                   | 35.2  | 112                        | 64                                    |
| Lenoir Co.            | 59,428          | 56,622          | -2,806                  | -5                        | 20.6                                   | 31.7                                   | 17.3  | 54                         | 0                                     |
| Lincoln Co.           | 43,361          | 82,557          | 39,196                  | 90                        | 11.6                                   | 43.8                                   | 50.3  | 278                        | 48                                    |
| McDowell Co.          | 35,838          | 45,083          | 9,245                   | 26                        | 15.0                                   | 33.9                                   | 29.5  | 126                        | 28                                    |
| Macon Co.             | 21,677          | 34,581          | 12,904                  | 60                        | 20.5                                   | 44.0                                   | 36.7  | 115                        | 61                                    |
| Madison Co.           | 16,919          | 21,563          | 4,644                   | 27                        | 7.3                                    | 16.1                                   | 13.8  | 121                        | 31                                    |
| Martin Co.            | 26,089          | 22,763          | -3,326                  | -13                       | 12.7                                   | 19.6                                   | 10.8  | 54                         | 0                                     |

| North Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Mecklenburg Co.       | 422,435         | 1,078,128       | 655,693                 | 155                       | 146.9                                  | 282.1                                  | 211.3   | 92                         | 100                                   |
| Mitchell Co.          | 14,316          | 14,992          | 676                     | 5                         | 3.5                                    | 13.7                                   | 15.9  | 291                        | 3                                     |
| Montgomery Co.        | 22,495          | 27,269          | 4,774                   | 21                        | 11.7                                   | 20.7                                   | 14.1  | 77                         | 34                                    |
| Moore Co.             | 51,394          | 97,368          | 45,974                  | 89                        | 29.2                                   | 75.8                                   | 72.8  | 160                        | 67                                    |
| Nash Co.              | 68,784          | 94,019          | 25,235                  | 37                        | 26.4                                   | 57.9                                   | 49.2  | 119                        | 40                                    |
| New Hanover Co.       | 107,489         | 228,728         | 121,239                 | 113                       | 34.3                                   | 70.2                                   | 56.1  | 105                        | 100                                   |
| Northampton Co.       | 21,941          | 19,890          | -2,051                  | -9                        | 9.1                                    | 16.6                                   | 11.7  | 82                         | 0                                     |
| Onslow Co.            | 118,881         | 195,066         | 76,185                  | 64                        | 32.5                                   | 81.1                                   | 75.9  | 150                        | 54                                    |
| Orange Co.            | 78,644          | 143,626         | 64,982                  | 83                        | 27.7                                   | 56.6                                   | 45.2  | 104                        | 84                                    |
| Pamlico Co.           | 10,636          | 12,638          | 2,002                   | 19                        | 6.8                                    | 13.4                                   | 10.3  | 97                         | 25                                    |
| Pasquotank Co.        | 28,781          | 39,386          | 10,605                  | 37                        | 9.6                                    | 20.4                                   | 16.9  | 113                        | 42                                    |
| Pender Co.            | 22,903          | 60,719          | 37,816                  | 165                       | 11.7                                   | 27.2                                   | 24.2  | 132                        | 100                                   |

| North Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Perquimans Co.        | 9,420           | 13,439          | 4,019                   | 43                        | 2.9                                    | 11.2                                   | 13.0  | 286                        | 26                                    |
| Person Co.            | 29,356          | 39,338          | 9,982                   | 34                        | 7.5                                    | 24.3                                   | 26.3  | 224                        | 25                                    |
| Pitt Co.              | 93,400          | 178,607         | 85,207                  | 91                        | 30.7                                   | 72.4                                   | 65.2  | 136                        | 76                                    |
| Polk Co.              | 13,799          | 20,564          | 6,765                   | 49                        | 10.5                                   | 25.8                                   | 23.9  | 146                        | 44                                    |
| Randolph Co.          | 93,626          | 143,037         | 49,411                  | 53                        | 37.1                                   | 80.9                                   | 68.4  | 118                        | 54                                    |
| Richmond Co.          | 44,468          | 44,827          | 359                     | 1                         | 26.6                                   | 38.4                                   | 18.4  | 44                         | 2                                     |
| Robeson Co.           | 103,114         | 132,626         | 29,512                  | 29                        | 38.6                                   | 73.2                                   | 54.1  | 90                         | 39                                    |
| Rockingham Co.        | 84,428          | 90,791          | 6,363                   | 8                         | 25.4                                   | 57.4                                   | 50.0  | 126                        | 9                                     |
| Rowan Co.             | 101,319         | 140,356         | 39,037                  | 39                        | 43.9                                   | 86.0                                   | 65.8  | 96                         | 48                                    |
| Rutherford Co.        | 55,280          | 66,529          | 11,249                  | 20                        | 14.8                                   | 51.6                                   | 57.5  | 249                        | 15                                    |
| Sampson Co.           | 49,170          | 63,263          | 14,093                  | 29                        | 22.0                                   | 42.4                                   | 31.9  | 93                         | 38                                    |
| Scotland Co.          | 32,839          | 35,174          | 2,335                   | 7                         | 15.7                                   | 24.1                                   | 13.1  | 54                         | 16                                    |

| North Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Stanly Co.            | 48,757          | 61,505          | 12,748                  | 26                        | 20.5                                   | 36.6                                   | 25.2  | 79                         | 40                                    |
| Stokes Co.            | 34,256          | 45,724          | 11,468                  | 33                        | 17.7                                   | 34.7                                   | 26.6  | 96                         | 43                                    |
| Surry Co.             | 59,896          | 72,107          | 12,211                  | 20                        | 22.5                                   | 42.7                                   | 31.6  | 90                         | 29                                    |
| Swain Co.             | 10,633          | 14,263          | 3,630                   | 34                        | 11.4                                   | 17.4                                   | 9.4   | 53                         | 69                                    |
| Transylvania Co.      | 24,095          | 33,767          | 9,672                   | 40                        | 14.8                                   | 36.8                                   | 34.4  | 149                        | 37                                    |
| Tyrrell Co.           | 4,059           | 4,180           | 121                     | 3                         | 3.6                                    | 4.4                                    | 1.3   | 22                         | 15                                    |
| Union Co.             | 73,308          | 231,350         | 158,042                 | 216                       | 28.1                                   | 74.4                                   | 72.3  | 165                        | 100                                   |
| Vance Co.             | 37,206          | 44,281          | 7,075                   | 19                        | 9.5                                    | 27.3                                   | 27.8  | 187                        | 16                                    |
| Wake Co.              | 316,973         | 1,071,706       | 754,733                 | 238                       | 112.1                                  | 294.3                                  | 284.7   | 163                        | 100                                   |
| Warren Co.            | 16,293          | 19,849          | 3,556                   | 22                        | 9.7                                    | 19.8                                   | 15.8  | 104                        | 28                                    |
| Washington Co.        | 14,476          | 11,944          | -2,532                  | -17                       | 5.3                                    | 10.6                                   | 8.3   | 100                        | 0                                     |
| Watauga Co.           | 33,549          | 55,181          | 21,632                  | 64                        | 18.1                                   | 41.0                                   | 35.8  | 127                        | 61                                    |

| North Carolina County   | 1982 Population  | 2017 Population   | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|-------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Wayne Co.               | 98,603           | 123,034           | 24,431                  | 25                        | 22.4                                   | 48.3                                   | 40.5  | 116                        | 29                                    |
| Wilkes Co.              | 59,191           | 68,489            | 9,298                   | 16                        | 23.0                                   | 49.1                                   | 40.8  | 113                        | 19                                    |
| Wilson Co.              | 63,816           | 81,436            | 17,620                  | 28                        | 21.7                                   | 37.7                                   | 25.0  | 74                         | 44                                    |
| Yadkin Co.              | 29,072           | 37,588            | 8,516                   | 29                        | 12.5                                   | 27.4                                   | 23.3  | 119                        | 33                                    |
| Yancey Co.              | 15,117           | 17,697            | 2,580                   | 17                        | 8.5                                    | 19.5                                   | 17.2  | 129                        | 19                                    |
| <b>Totals</b>           | <b>6,019,108</b> | <b>10,268,233</b> | <b>4,249,125</b>        | <b>71</b>                 | <b>2,358.7</b>                         | <b>4,915.8</b>                         | <b>3,995.5</b>                                    | <b>108</b>                 | <b>73</b>                             |
| <b>Weighted Average</b> |                  |                   |                         |                           |  |  |   |                            | <b>60</b>                             |



**Scatter Plot for North Carolina County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.95**

**North Dakota**

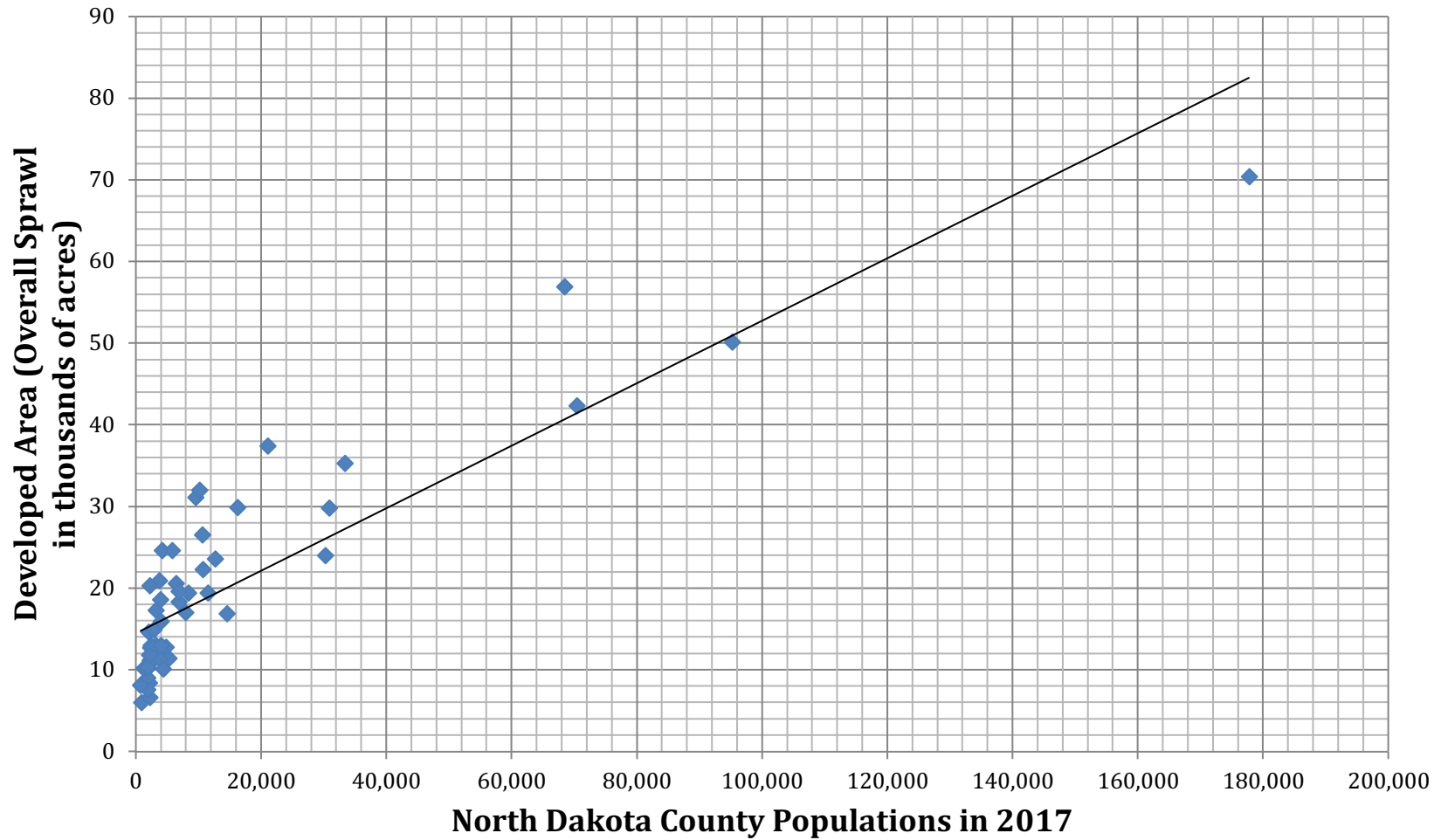
| <b>North Dakota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adams Co.                  | 3,472                  | 2,324                  | -1,148                         | -33                              | 9.5   | 11.1  | 2.5  | 17                                | 0  |
| Barnes Co.                 | 13,692                 | 10,679                 | -3,013                         | -22                              | 24.1  | 26.5  | 3.8  | 10                                | 0  |
| Benson Co.                 | 7,746                  | 6,916                  | -830                           | -11                              | 17.0  | 18.3  | 2.0  | 8                                 | 0  |
| Billings Co.               | 1,213                  | 922                    | -291                           | -24                              | 4.3   | 6.0   | 2.7  | 40                                | 0  |
| Bottineau Co.              | 9,342                  | 6,522                  | -2,820                         | -30                              | 20.2  | 20.6  | 0.6  | 2                                 | 0  |
| Bowman Co.                 | 4,271                  | 3,150                  | -1,121                         | -26                              | 10.3  | 12.0  | 2.7  | 17                                | 0  |
| Burke Co.                  | 3,783                  | 2,128                  | -1,655                         | -44                              | 14.6  | 14.6  | 0.0  | 0                                 | 0  |
| Burleigh Co.               | 56,491                 | 95,247                 | 38,756                         | 69                               | 37.4  | 50.1  | 19.8   | 34                                | 100  |
| Cass Co.                   | 91,063                 | 177,745                | 86,682                         | 95                               | 57.9  | 70.4  | 19.5   | 22                                | 100  |
| Cavalier Co.               | 7,196                  | 3,793                  | -3,403                         | -47                              | 19.9  | 20.9  | 1.6  | 5                                 | 0  |
| Dickey Co.                 | 7,041                  | 4,848                  | -2,193                         | -31                              | 12.8  | 12.8  | 0.0  | 0                                 | 0  |

| <b>North Dakota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Divide Co.                 | 3,404                  | 2,295                  | -1,109                         | -33                              | 17.1  | 20.3  | 5.0  | 19                                | 0  |
| Dunn Co.                   | 4,920                  | 4,274                  | -646                           | -13                              | 16.9  | 24.6  | 12.0   | 46                                | 0  |
| Eddy Co.                   | 3,486                  | 2,315                  | -1,171                         | -34                              | 5.9   | 6.6   | 1.1  | 12                                | 0  |
| Emmons Co.                 | 5,695                  | 3,298                  | -2,397                         | -42                              | 15.1  | 17.3  | 3.4  | 15                                | 0  |
| Foster Co.                 | 4,587                  | 3,249                  | -1,338                         | -29                              | 9.3   | 13.0  | 5.8  | 40                                | 0  |
| Golden Valley Co.          | 2,632                  | 1,779                  | -853                           | -32                              | 8.2   | 10.0  | 2.8  | 22                                | 0  |
| Grand Forks Co.            | 67,538                 | 70,489                 | 2,951                          | 4                                | 39.6  | 42.3  | 4.2  | 7                                 | 65   |
| Grant Co.                  | 4,204                  | 2,363                  | -1,841                         | -44                              | 12.3  | 12.7  | 0.6  | 3                                 | 0  |
| Griggs Co.                 | 3,673                  | 2,244                  | -1,429                         | -39                              | 8.5   | 8.4   | -0.2   | -1                                | 0  |
| Hettinger Co.              | 4,072                  | 2,479                  | -1,593                         | -39                              | 12.4  | 13.0  | 0.9  | 5                                 | 0  |
| Kidder Co.                 | 3,687                  | 2,471                  | -1,216                         | -33                              | 10.9  | 11.0  | 0.2  | 1                                 | 0  |

| <b>North Dakota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| LaMoure Co.                | 6,218                  | 4,101                  | -2,117                         | -34                              | 15.4  | 15.9  | 0.8  | 3                                 | 0  |
| Logan Co.                  | 3,338                  | 1,919                  | -1,419                         | -43                              | 8.1   | 9.0   | 1.4  | 11                                | 0  |
| McHenry Co.                | 7,585                  | 5,890                  | -1,695                         | -22                              | 23.3  | 24.6  | 2.0  | 6                                 | 0  |
| McIntosh Co.               | 4,562                  | 2,608                  | -1,954                         | -43                              | 11.4  | 12.7  | 2.0  | 11                                | 0  |
| McKenzie Co.               | 8,711                  | 12,688                 | 3,977                          | 46                               | 13.4  | 23.6  | 15.9   | 76                                | 66   |
| McLean Co.                 | 12,250                 | 9,636                  | -2,614                         | -21                              | 27.8  | 31.1  | 5.2  | 12                                | 0  |
| Mercer Co.                 | 10,162                 | 8,457                  | -1,705                         | -17                              | 14.7  | 19.4  | 7.3  | 32                                | 0  |
| Morton Co.                 | 25,586                 | 30,938                 | 5,352                          | 21                               | 26.7  | 29.8  | 4.8  | 12                                | 100  |
| Mountrail Co.              | 7,880                  | 10,276                 | 2,396                          | 30                               | 19.6  | 32.0  | 19.4   | 63                                | 54   |
| Nelson Co.                 | 4,992                  | 2,902                  | -2,090                         | -42                              | 14.3  | 14.9  | 0.9  | 4                                 | 0  |
| Oliver Co.                 | 2,505                  | 1,930                  | -575                           | -23                              | 5.9   | 7.6   | 2.7  | 29                                | 0  |
| Pembina Co.                | 10,198                 | 6,962                  | -3,236                         | -32                              | 18.5  | 19.6  | 1.7  | 6                                 | 0  |

| North Dakota County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Pierce Co.          | 6,067           | 4,096           | -1,971                  | -32                       | 12.7                                   | 13.0                                   | 0.5   | 2                          | 0                                     |
| Ramsey Co.          | 12,965          | 11,596          | -1,369                  | -11                       | 15.5                                   | 19.4                                   | 6.1   | 25                         | 0                                     |
| Ransom Co.          | 6,486           | 5,303           | -1,183                  | -18                       | 10.2                                   | 11.4                                   | 1.9   | 12                         | 0                                     |
| Renville Co.        | 3,584           | 2,455           | -1,129                  | -32                       | 10.3                                   | 10.9                                   | 0.9   | 6                          | 0                                     |
| Richland Co.        | 19,366          | 16,287          | -3,079                  | -16                       | 25.4                                   | 29.9                                   | 7.0   | 18                         | 0                                     |
| Rolette Co.         | 12,355          | 14,614          | 2,259                   | 18                        | 15.4                                   | 16.9                                   | 2.3   | 10                         | 100                                   |
| Sargent Co.         | 5,325           | 3,862           | -1,463                  | -27                       | 10.1                                   | 11.3                                   | 1.9   | 12                         | 0                                     |
| Sheridan Co.        | 2,593           | 1,351           | -1,242                  | -48                       | 10.2                                   | 10.2                                   | 0.0   | 0                          | 0                                     |
| Sioux Co.           | 3,646           | 4,425           | 779                     | 21                        | 7.1                                    | 10.1                                   | 4.7   | 42                         | 55                                    |
| Slope Co.           | 1,129           | 767             | -362                    | -32                       | 6.8                                    | 8.1                                    | 2.0   | 19                         | 0                                     |
| Stark Co.           | 28,107          | 30,291          | 2,184                   | 8                         | 21.8                                   | 24.0                                   | 3.4   | 10                         | 78                                    |
| Steele Co.          | 2,909           | 1,906           | -1,003                  | -34                       | 10.1                                   | 10.3                                   | 0.3   | 2                          | 0                                     |

| North Dakota County     | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Stutsman Co.            | 24,015          | 21,132          | -2,883                  | -12                       | 35.8                                   | 37.4                                   | 2.5   | 4                          | 0                                     |
| Towner Co.              | 4,033           | 2,244           | -1,789                  | -44                       | 11.3                                   | 11.8                                   | 0.8   | 4                          | 0                                     |
| Traill Co.              | 9,446           | 7,998           | -1,448                  | -15                       | 16.1                                   | 17.0                                   | 1.4   | 6                          | 0                                     |
| Walsh Co.               | 15,379          | 10,801          | -4,578                  | -30                       | 22.3                                   | 22.3                                   | 0.0   | 0                          | 0                                     |
| Ward Co.                | 59,935          | 68,516          | 8,581                   | 14                        | 44.2                                   | 56.9                                   | 19.8  | 29                         | 53                                    |
| Wells Co.               | 6,839           | 3,994           | -2,845                  | -42                       | 16.5                                   | 18.6                                   | 3.3   | 13                         | 0                                     |
| Williams Co.            | 27,598          | 33,467          | 5,869                   | 21                        | 23.4                                   | 35.3                                   | 18.6  | 51                         | 47                                    |
| <b>Totals</b>           | <b>668,972</b>  | <b>754,942</b>  | <b>85,970</b>           | <b>13</b>                 | <b>908.5</b>                           | <b>1,057.5</b>                         | <b>232.8</b>                                      | <b>16</b>                  | <b>80</b>                             |
| <b>Weighted Average</b> |                 |                 |                         |                           |  |  |   |                            | <b>41</b>                             |



**Scatter Plot for North Dakota County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.87**

**Ohio**

| <b>Ohio County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adams Co.          | 24,459                 | 27,753                 | 3,294                          | 13                               | 9.4   | 20.3  | 17.0   | 116                               | 16   |
| Allen Co.          | 109,826                | 103,093                | -6,733                         | -6                               | 35.3  | 49.7  | 22.5   | 41                                | 0  |
| Ashland Co.        | 46,427                 | 53,662                 | 7,235                          | 16                               | 13.7  | 25.0  | 17.7   | 82                                | 24   |
| Ashtabula Co.      | 102,945                | 97,748                 | -5,197                         | -5                               | 31.7  | 50.4  | 29.2   | 59                                | 0  |
| Athens Co.         | 57,432                 | 66,503                 | 9,071                          | 16                               | 10.4  | 18.0  | 11.9   | 73                                | 27   |
| Auglaize Co.       | 42,899                 | 45,753                 | 2,854                          | 7                                | 13.7  | 20.8  | 11.1   | 52                                | 15   |
| Belmont Co.        | 81,403                 | 68,002                 | -13,401                        | -16                              | 21.1  | 29.8  | 13.6   | 41                                | 0  |
| Brown Co.          | 32,150                 | 43,523                 | 11,373                         | 35                               | 13.4  | 24.1  | 16.7   | 80                                | 52   |
| Butler Co.         | 262,015                | 380,607                | 118,592                        | 45                               | 52.4  | 95.8  | 67.8   | 83                                | 62   |
| Carroll Co.        | 25,701                 | 27,324                 | 1,623                          | 6                                | 10.0  | 15.9  | 9.2  | 59                                | 13   |
| Champaign Co.      | 33,780                 | 38,851                 | 5,071                          | 15                               | 15.5  | 25.4  | 15.5   | 64                                | 28   |

| <b>Ohio County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Clark Co.          | 147,821                | 134,549                | -13,272                        | -9                               | 43.3  | 57.1  | 21.6   | 32                                | 0  |
| Clermont Co.       | 132,719                | 204,260                | 71,541                         | 54                               | 42.4  | 80.3  | 59.2   | 89                                | 68   |
| Clinton Co.        | 34,210                 | 42,004                 | 7,794                          | 23                               | 8.6   | 21.5  | 20.2   | 150                               | 22   |
| Columbiana Co.     | 112,463                | 103,062                | -9,401                         | -8                               | 42.1  | 55.8  | 21.4   | 33                                | 0  |
| Coshocton Co.      | 36,146                 | 36,536                 | 390                            | 1                                | 14.1  | 20.0  | 9.2  | 42                                | 3  |
| Crawford Co.       | 49,232                 | 41,710                 | -7,522                         | -15                              | 16.8  | 22.7  | 9.2  | 35                                | 0  |
| Cuyahoga Co.       | 1,474,693              | 1,247,581              | -227,112                       | -15                              | 199.3   | 233.1   | 52.8   | 17                                | 0  |
| Darke Co.          | 53,414                 | 51,549                 | -1,865                         | -3                               | 21.1  | 29.5  | 13.1   | 40                                | 0  |
| Defiance Co.       | 39,263                 | 38,156                 | -1,107                         | -3                               | 14.3  | 22.5  | 12.8   | 57                                | 0  |
| Delaware Co.       | 55,722                 | 200,870                | 145,148                        | 260                              | 35.1  | 80.3  | 70.6   | 129                               | 100  |
| Erie Co.           | 78,098                 | 74,760                 | -3,338                         | -4                               | 26.0  | 37.3  | 17.7   | 43                                | 0  |
| Fairfield Co.      | 95,772                 | 154,686                | 58,914                         | 62                               | 43.6  | 68.9  | 39.5   | 58                                | 100  |

| <b>Ohio County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Fayette Co.        | 27,235                 | 28,639                 | 1,404                          | 5                                | 9.0   | 17.0  | 12.5   | 89                                | 8  |
| Franklin Co.       | 880,292                | 1,295,510              | 415,218                        | 47                               | 180.8   | 241.4   | 94.7   | 34                                | 100  |
| Fulton Co.         | 37,513                 | 42,265                 | 4,752                          | 13                               | 21.8  | 28.7  | 10.8   | 32                                | 43   |
| Gallia Co.         | 29,972                 | 30,162                 | 190                            | 1                                | 8.5   | 16.6  | 12.7   | 95                                | 1  |
| Geauga Co.         | 74,939                 | 93,881                 | 18,942                         | 25                               | 50.5  | 84.0  | 52.3   | 66                                | 44   |
| Greene Co.         | 130,099                | 166,566                | 36,467                         | 28                               | 33.7  | 69.8  | 56.4   | 107                               | 34   |
| Guernsey Co.       | 41,708                 | 39,066                 | -2,642                         | -6                               | 18.4  | 29.1  | 16.7   | 58                                | 0  |
| Hamilton Co.       | 871,027                | 814,170                | -56,857                        | -7                               | 166.1   | 196.3   | 47.2   | 18                                | 0  |
| Hancock Co.        | 64,889                 | 75,973                 | 11,084                         | 17                               | 13.3  | 25.7  | 19.4   | 93                                | 24   |
| Hardin Co.         | 32,041                 | 31,329                 | -712                           | -2                               | 9.0   | 14.1  | 8.0  | 57                                | 0  |
| Harrison Co.       | 17,669                 | 15,202                 | -2,467                         | -14                              | 10.1  | 13.1  | 4.7  | 30                                | 0  |
| Henry Co.          | 28,159                 | 27,179                 | -980                           | -3                               | 13.6  | 19.9  | 9.8  | 46                                | 0  |

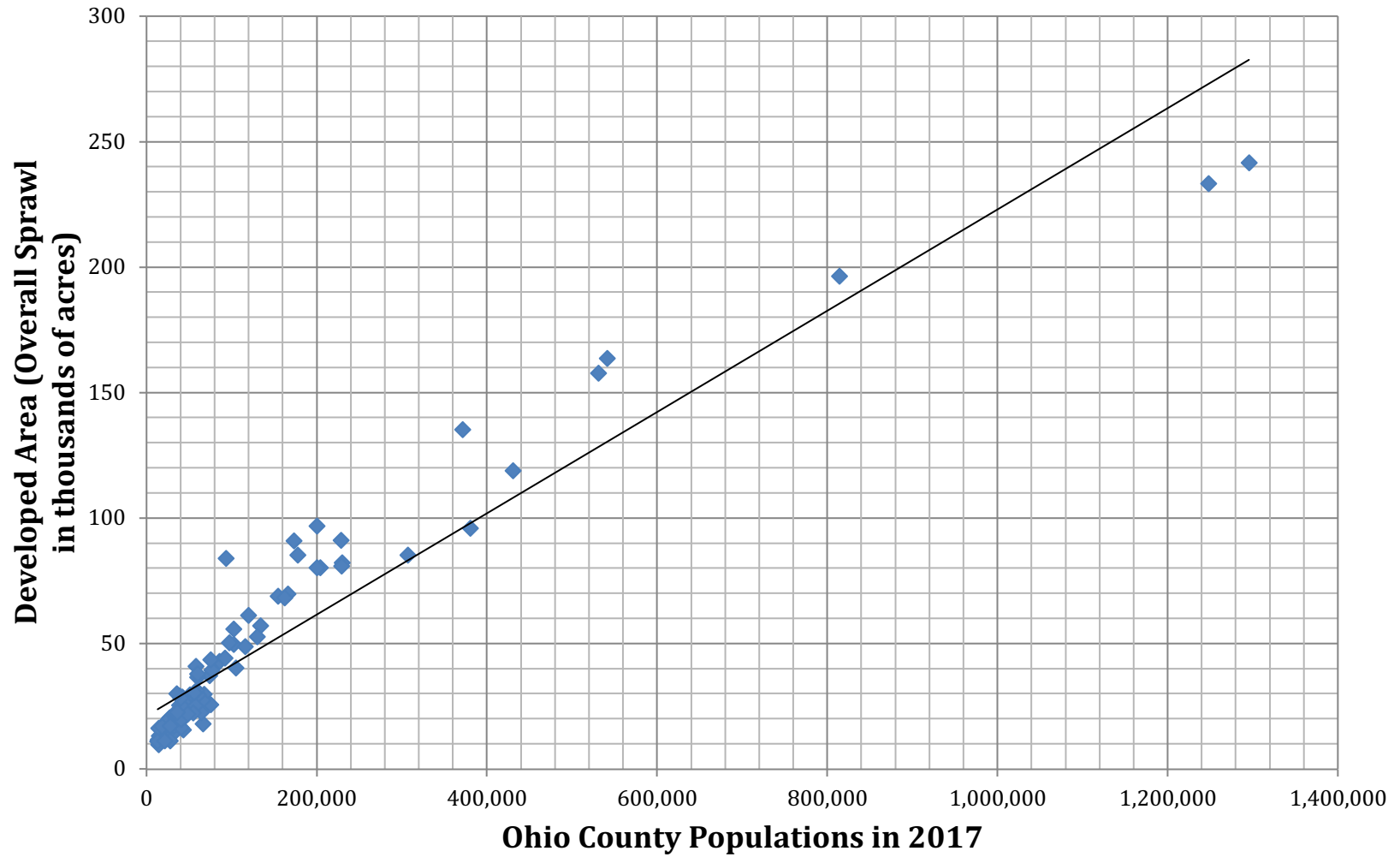
| <b>Ohio County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Highland Co.       | 33,600                 | 42,903                 | 9,303                          | 28                               | 13.2  | 25.8  | 19.7   | 95                                | 36   |
| Hocking Co.        | 24,118                 | 28,436                 | 4,318                          | 18                               | 9.2   | 17.4  | 12.8   | 89                                | 26   |
| Holmes Co.         | 30,273                 | 43,895                 | 13,622                         | 45                               | 8.3   | 15.5  | 11.3   | 87                                | 59   |
| Huron Co.          | 54,355                 | 58,393                 | 4,038                          | 7                                | 26.1  | 40.9  | 23.1   | 57                                | 16   |
| Jackson Co.        | 30,477                 | 32,386                 | 1,909                          | 6                                | 9.7   | 17.2  | 11.7   | 77                                | 11   |
| Jefferson Co.      | 89,547                 | 66,318                 | -23,229                        | -26                              | 18.7  | 27.3  | 13.4   | 46                                | 0  |
| Knox Co.           | 46,706                 | 61,271                 | 14,565                         | 31                               | 21.0  | 29.5  | 13.3   | 40                                | 80   |
| Lake Co.           | 214,281                | 230,159                | 15,878                         | 7                                | 60.9  | 82.2  | 33.3   | 35                                | 24   |
| Lawrence Co.       | 63,309                 | 60,075                 | -3,234                         | -5                               | 23.2  | 36.5  | 20.8   | 57                                | 0  |
| Licking Co.        | 123,336                | 173,617                | 50,281                         | 41                               | 48.3  | 90.8  | 66.4   | 88                                | 54   |
| Logan Co.          | 39,306                 | 45,198                 | 5,892                          | 15                               | 17.3  | 26.5  | 14.4   | 53                                | 33   |
| Lorain Co.         | 271,800                | 307,441                | 35,641                         | 13                               | 53.2  | 85.2  | 50.0   | 60                                | 26   |

| <b>Ohio County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Lucas Co.          | 468,648                | 431,039                | -37,609                        | -8                               | 87.5  | 118.8   | 48.9   | 36                                | 0  |
| Madison Co.        | 33,879                 | 44,041                 | 10,162                         | 30                               | 13.6  | 24.3  | 16.7   | 79                                | 45   |
| Mahoning Co.       | 283,178                | 229,791                | -53,387                        | -19                              | 53.8  | 80.8  | 42.2   | 50                                | 0  |
| Marion Co.         | 67,153                 | 65,076                 | -2,077                         | -3                               | 19.3  | 22.5  | 5.0  | 17                                | 0  |
| Medina Co.         | 114,977                | 178,176                | 63,199                         | 55                               | 50.4  | 85.2  | 54.4   | 69                                | 83   |
| Meigs Co.          | 23,661                 | 23,071                 | -590                           | -2                               | 9.6   | 18.6  | 14.1   | 94                                | 0  |
| Mercer Co.         | 38,369                 | 40,858                 | 2,489                          | 6                                | 12.7  | 16.4  | 5.8  | 29                                | 25   |
| Miami Co.          | 90,265                 | 105,200                | 14,935                         | 17                               | 30.5  | 40.3  | 15.3   | 32                                | 55   |
| Monroe Co.         | 16,838                 | 13,931                 | -2,907                         | -17                              | 7.6   | 11.6  | 6.3  | 53                                | 0  |
| Montgomery Co.     | 565,803                | 531,467                | -34,336                        | -6                               | 134.5   | 157.7   | 36.3   | 17                                | 0  |
| Morgan Co.         | 14,137                 | 14,644                 | 507                            | 4                                | 5.7   | 9.8   | 6.4  | 72                                | 7  |
| Morrow Co.         | 26,606                 | 34,911                 | 8,305                          | 31                               | 9.9   | 20.4  | 16.4   | 106                               | 38   |

| <b>Ohio County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Muskingum Co.      | 83,728                 | 86,123                 | 2,395                          | 3                                | 27.8  | 42.9  | 23.6   | 54                                | 7  |
| Noble Co.          | 11,170                 | 14,400                 | 3,230                          | 29                               | 8.9   | 16.3  | 11.6   | 83                                | 42   |
| Ottawa Co.         | 39,722                 | 40,623                 | 901                            | 2                                | 17.2  | 28.2  | 17.2   | 64                                | 5  |
| Paulding Co.       | 20,901                 | 18,831                 | -2,070                         | -10                              | 10.9  | 16.9  | 9.4  | 55                                | 0  |
| Perry Co.          | 31,371                 | 35,972                 | 4,601                          | 15                               | 18.2  | 30.0  | 18.4   | 65                                | 27   |
| Pickaway Co.       | 42,971                 | 57,740                 | 14,769                         | 34                               | 16.2  | 25.2  | 14.1   | 56                                | 67   |
| Pike Co.           | 23,737                 | 28,088                 | 4,351                          | 18                               | 7.3   | 17.2  | 15.5   | 136                               | 20   |
| Portage Co.        | 138,090                | 162,473                | 24,383                         | 18                               | 40.1  | 68.2  | 43.9   | 70                                | 31   |
| Preble Co.         | 37,883                 | 41,116                 | 3,233                          | 9                                | 11.4  | 19.8  | 13.1   | 74                                | 15   |
| Putnam Co.         | 32,962                 | 33,860                 | 898                            | 3                                | 17.0  | 22.3  | 8.3  | 31                                | 10   |
| Richland Co.       | 129,141                | 120,430                | -8,711                         | -7                               | 46.1  | 61.1  | 23.4   | 33                                | 0  |
| Ross Co.           | 65,649                 | 77,295                 | 11,646                         | 18                               | 25.9  | 39.4  | 21.1   | 52                                | 39   |

| <b>Ohio County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Sandusky Co.       | 62,180                 | 59,093                 | -3,087                         | -5                               | 21.0  | 31.3  | 16.1   | 49                                | 0  |
| Scioto Co.         | 84,297                 | 75,976                 | -8,321                         | -10                              | 26.0  | 43.5  | 27.3   | 67                                | 0  |
| Seneca Co.         | 61,093                 | 55,267                 | -5,826                         | -10                              | 18.6  | 22.4  | 5.9  | 20                                | 0  |
| Shelby Co.         | 43,275                 | 48,738                 | 5,463                          | 13                               | 14.5  | 22.0  | 11.7   | 52                                | 29   |
| Stark Co.          | 375,915                | 372,003                | -3,912                         | -1                               | 95.2  | 135.2   | 62.5   | 42                                | 0  |
| Summit Co.         | 518,036                | 541,514                | 23,478                         | 5                                | 110.7   | 163.6   | 82.7   | 48                                | 11   |
| Trumbull Co.       | 239,152                | 200,281                | -38,871                        | -16                              | 79.0  | 96.8  | 27.8   | 23                                | 0  |
| Tuscarawas Co.     | 84,820                 | 92,308                 | 7,488                          | 9                                | 28.2  | 44.2  | 25.0   | 57                                | 19   |
| Union Co.          | 29,914                 | 56,798                 | 26,884                         | 90                               | 15.4  | 30.4  | 23.4   | 97                                | 94   |
| Van Wert Co.       | 30,217                 | 28,283                 | -1,934                         | -6                               | 9.2   | 11.3  | 3.3  | 23                                | 0  |
| Vinton Co.         | 11,299                 | 13,082                 | 1,783                          | 16                               | 6.4   | 11.0  | 7.2  | 72                                | 27   |
| Warren Co.         | 100,581                | 228,709                | 128,128                        | 127                              | 44.1  | 91.0  | 73.3   | 106                               | 100  |

| <b>Ohio County</b>      | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Washington Co.          | 64,529                 | 60,491                 | -4,038                         | -6                               | 28.3  | 37.8  | 14.8   | 34                                | 0  |
| Wayne Co.               | 98,039                 | 116,168                | 18,129                         | 18                               | 33.4  | 48.8  | 24.1   | 46                                | 45   |
| Williams Co.            | 36,203                 | 36,707                 | 504                            | 1                                | 17.3  | 22.6  | 8.3  | 31                                | 5  |
| Wood Co.                | 108,830                | 130,437                | 21,607                         | 20                               | 36.2  | 52.7  | 25.8   | 46                                | 48   |
| Wyandot Co.             | 22,625                 | 22,063                 | -562                           | -2                               | 6.5   | 11.3  | 7.5  | 74                                | 0  |
| <b>Totals</b>           | <b>10,757,085</b>      | <b>11,659,650</b>      | <b>902,565</b>                 | <b>8</b>                         | <b>2,849.3</b>                                | <b>4,224.5</b>                                | <b>2,148.8</b>   | <b>48</b>                         | <b>20</b>                                    |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>34</b>                                    |



**Scatter Plot for Ohio County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.95**

**Oklahoma**

| Oklahoma County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Adair Co.       | 18,437          | 22,119          | 3,682                   | 20                        | 3.7                                    | 9.4                                    | 8.9   | 154                        | 20                                    |
| Alfalfa Co.     | 7,380           | 5,913           | -1,467                  | -20                       | 16.4                                   | 18.7                                   | 3.6   | 14                         | 0                                     |
| Atoka Co.       | 12,811          | 13,779          | 968                     | 8                         | 12.6                                   | 16.7                                   | 6.4   | 33                         | 26                                    |
| Beaver Co.      | 7,129           | 5,364           | -1,765                  | -25                       | 26.7                                   | 31.3                                   | 7.2   | 17                         | 0                                     |
| Beckham Co.     | 25,027          | 21,779          | -3,248                  | -13                       | 12.0                                   | 18.8                                   | 10.6  | 57                         | 0                                     |
| Blaine Co.      | 14,968          | 9,512           | -5,456                  | -36                       | 17.1                                   | 18.9                                   | 2.8   | 11                         | 0                                     |
| Bryan Co.       | 30,527          | 46,481          | 15,954                  | 52                        | 17.4                                   | 32.0                                   | 22.8  | 84                         | 69                                    |
| Caddo Co.       | 33,479          | 29,356          | -4,123                  | -12                       | 26.9                                   | 39.7                                   | 20.0  | 48                         | 0                                     |
| Canadian Co.    | 64,245          | 140,001         | 75,756                  | 118                       | 25.4                                   | 56.1                                   | 48.0  | 121                        | 98                                    |
| Carter Co.      | 46,062          | 48,273          | 2,211                   | 5                         | 22.7                                   | 35.3                                   | 19.7  | 56                         | 11                                    |
| Cherokee Co.    | 30,863          | 48,891          | 18,028                  | 58                        | 6.1                                    | 15.1                                   | 14.1  | 148                        | 51                                    |

| Oklahoma County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Choctaw Co.     | 16,655          | 14,804          | -1,851                  | -11                       | 6.7                                    | 10.3                                   | 5.6   | 54                         | 0                                     |
| Cimarron Co.    | 3,648           | 2,152           | -1,496                  | -41                       | 15.0                                   | 16.0                                   | 1.6   | 7                          | 0                                     |
| Cleveland Co.   | 148,470         | 279,542         | 131,072                 | 88                        | 31.4                                   | 78.3                                   | 73.3  | 149                        | 69                                    |
| Coal Co.        | 5,972           | 5,630           | -342                    | -6                        | 3.3                                    | 5.0                                    | 2.7   | 52                         | 0                                     |
| Comanche Co.    | 119,414         | 121,786         | 2,372                   | 2                         | 31.4                                   | 45.4                                   | 21.9  | 45                         | 5                                     |
| Cotton Co.      | 7,004           | 5,863           | -1,141                  | -16                       | 13.2                                   | 14.8                                   | 2.5   | 12                         | 0                                     |
| Craig Co.       | 15,076          | 14,332          | -744                    | -5                        | 7.4                                    | 9.7                                    | 3.6   | 31                         | 0                                     |
| Creek Co.       | 63,238          | 71,890          | 8,652                   | 14                        | 28.9                                   | 43.2                                   | 22.3  | 49                         | 32                                    |
| Custer Co.      | 31,078          | 28,974          | -2,104                  | -7                        | 22.3                                   | 29.9                                   | 11.9  | 34                         | 0                                     |
| Delaware Co.    | 25,340          | 42,672          | 17,332                  | 68                        | 13.1                                   | 24.4                                   | 17.7  | 86                         | 84                                    |
| Dewey Co.       | 6,501           | 4,899           | -1,602                  | -25                       | 13.7                                   | 15.5                                   | 2.8   | 13                         | 0                                     |
| Ellis Co.       | 6,410           | 3,970           | -2,440                  | -38                       | 17.5                                   | 20.6                                   | 4.8   | 18                         | 0                                     |

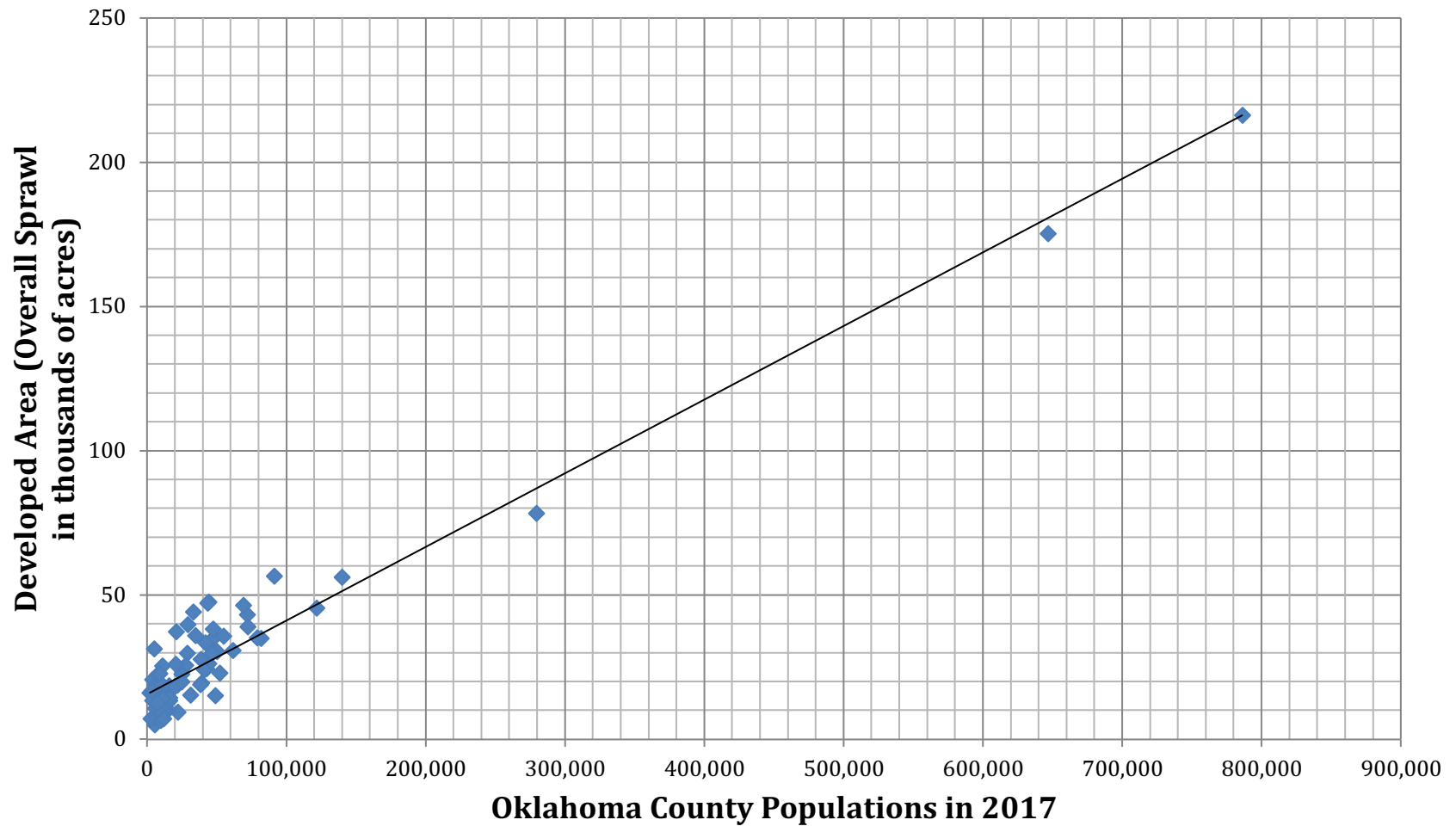
| Oklahoma County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Garfield Co.    | 67,597          | 61,600          | -5,997                  | -9                        | 25.4                                   | 30.8                                   | 8.4   | 21                         | 0                                     |
| Garvin Co.      | 29,893          | 27,857          | -2,036                  | -7                        | 20.9                                   | 25.7                                   | 7.5   | 23                         | 0                                     |
| Grady Co.       | 43,836          | 54,829          | 10,993                  | 25                        | 24.7                                   | 35.7                                   | 17.2  | 45                         | 61                                    |
| Grant Co.       | 6,669           | 4,379           | -2,290                  | -34                       | 13.9                                   | 15.4                                   | 2.3   | 11                         | 0                                     |
| Greer Co.       | 7,479           | 5,793           | -1,686                  | -23                       | 10.1                                   | 10.8                                   | 1.1   | 7                          | 0                                     |
| Harmon Co.      | 4,555           | 2,710           | -1,845                  | -41                       | 7.2                                    | 7.1                                    | -0.2  | -1                         | 0                                     |
| Harper Co.      | 5,046           | 3,784           | -1,262                  | -25                       | 12.4                                   | 13.4                                   | 1.6   | 8                          | 0                                     |
| Haskell Co.     | 11,153          | 12,726          | 1,573                   | 14                        | 4.9                                    | 10.0                                   | 8.0   | 104                        | 18                                    |
| Hughes Co.      | 14,522          | 13,265          | -1,257                  | -9                        | 10.0                                   | 14.2                                   | 6.6   | 42                         | 0                                     |
| Jackson Co.     | 30,292          | 25,112          | -5,180                  | -17                       | 19.3                                   | 22.5                                   | 5.0   | 17                         | 0                                     |
| Jefferson Co.   | 8,418           | 6,164           | -2,254                  | -27                       | 6.9                                    | 7.3                                    | 0.6   | 6                          | 0                                     |
| Johnston Co.    | 10,445          | 11,121          | 676                     | 6                         | 6.6                                    | 10.6                                   | 6.3   | 61                         | 13                                    |

| Oklahoma County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Kay Co.         | 52,236          | 44,403          | -7,833                  | -15                       | 23.3                                   | 26.2                                   | 4.5   | 12                         | 0                                     |
| Kingfisher Co.  | 16,193          | 15,688          | -505                    | -3                        | 14.9                                   | 18.5                                   | 5.6   | 24                         | 0                                     |
| Kiowa Co.       | 13,006          | 8,849           | -4,157                  | -32                       | 18.8                                   | 19.9                                   | 1.7   | 6                          | 0                                     |
| Latimer Co.     | 9,841           | 10,318          | 477                     | 5                         | 4.0                                    | 8.4                                    | 6.9   | 110                        | 6                                     |
| Le Flore Co.    | 40,561          | 50,020          | 9,459                   | 23                        | 18.7                                   | 30.4                                   | 18.3  | 63                         | 43                                    |
| Lincoln Co.     | 28,262          | 34,961          | 6,699                   | 24                        | 20.3                                   | 35.9                                   | 24.4  | 77                         | 37                                    |
| Logan Co.       | 28,684          | 46,785          | 18,101                  | 63                        | 17.5                                   | 29.9                                   | 19.4  | 71                         | 91                                    |
| Love Co.        | 7,862           | 10,076          | 2,214                   | 28                        | 3.1                                    | 6.6                                    | 5.5   | 113                        | 33                                    |
| McClain Co.     | 21,855          | 39,306          | 17,451                  | 80                        | 11.9                                   | 19.6                                   | 12.0  | 65                         | 100                                   |
| McCurtain Co.   | 35,179          | 33,031          | -2,148                  | -6                        | 30.1                                   | 44.2                                   | 22.0  | 47                         | 0                                     |
| McIntosh Co.    | 16,312          | 19,701          | 3,389                   | 21                        | 10.8                                   | 18.2                                   | 11.6  | 69                         | 36                                    |
| Major Co.       | 9,724           | 7,684           | -2,040                  | -21                       | 17.0                                   | 22.4                                   | 8.4   | 32                         | 0                                     |

| Oklahoma County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Marshall Co.    | 10,970          | 16,364          | 5,394                   | 49                        | 8.5                                    | 13.4                                   | 7.7   | 58                         | 88                                    |
| Mayes Co.       | 33,314          | 40,988          | 7,674                   | 23                        | 16.7                                   | 24.0                                   | 11.4  | 44                         | 57                                    |
| Murray Co.      | 13,031          | 13,918          | 887                     | 7                         | 9.9                                    | 14.4                                   | 7.0   | 45                         | 18                                    |
| Muskogee Co.    | 68,169          | 69,027          | 858                     | 1                         | 32.7                                   | 46.4                                   | 21.4  | 42                         | 4                                     |
| Noble Co.       | 11,820          | 11,303          | -517                    | -4                        | 11.2                                   | 9.5                                    | -2.7  | -15                        | 27                                    |
| Nowata Co.      | 11,970          | 10,322          | -1,648                  | -14                       | 6.5                                    | 8.9                                    | 3.8   | 37                         | 0                                     |
| Okfuskee Co.    | 11,732          | 12,076          | 344                     | 3                         | 5.1                                    | 7.1                                    | 3.1   | 39                         | 9                                     |
| Oklahoma Co.    | 601,966         | 786,068         | 184,102                 | 31                        | 133.1                                  | 216.3                                  | 130.0   | 63                         | 55                                    |
| Okmulgee Co.    | 39,882          | 38,819          | -1,063                  | -3                        | 21.3                                   | 27.7                                   | 10.0  | 30                         | 0                                     |
| Osage Co.       | 41,962          | 47,346          | 5,384                   | 13                        | 27.7                                   | 38.3                                   | 16.6  | 38                         | 37                                    |
| Ottawa Co.      | 32,859          | 31,368          | -1,491                  | -5                        | 10.6                                   | 15.3                                   | 7.3   | 44                         | 0                                     |
| Pawnee Co.      | 15,956          | 16,419          | 463                     | 3                         | 9.5                                    | 14.3                                   | 7.5   | 51                         | 7                                     |

| Oklahoma County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Payne Co.        | 65,104          | 81,908          | 16,804                  | 26                        | 21.6                                   | 34.9                                   | 20.8  | 62                         | 48                                    |
| Pittsburg Co.    | 40,566          | 44,154          | 3,588                   | 9                         | 35.6                                   | 47.6                                   | 18.8  | 34                         | 29                                    |
| Pontotoc Co.     | 33,891          | 38,371          | 4,480                   | 13                        | 12.8                                   | 19.0                                   | 9.7   | 48                         | 31                                    |
| Pottawatomie Co. | 59,025          | 72,185          | 13,160                  | 22                        | 26.9                                   | 39.0                                   | 18.9  | 45                         | 54                                    |
| Pushmataha Co.   | 11,667          | 11,118          | -549                    | -5                        | 9.8                                    | 14.2                                   | 6.9   | 45                         | 0                                     |
| Roger Mills Co.  | 6,001           | 3,661           | -2,340                  | -39                       | 11.1                                   | 16.8                                   | 8.9   | 51                         | 0                                     |
| Rogers Co.       | 51,241          | 91,435          | 40,194                  | 78                        | 27.8                                   | 56.6                                   | 45.0  | 104                        | 81                                    |
| Seminole Co.     | 28,473          | 24,845          | -3,628                  | -13                       | 13.2                                   | 19.8                                   | 10.3  | 50                         | 0                                     |
| Sequoyah Co.     | 30,997          | 41,742          | 10,745                  | 35                        | 8.4                                    | 33.5                                   | 39.2  | 299                        | 22                                    |
| Stephens Co.     | 46,669          | 43,340          | -3,329                  | -7                        | 26.3                                   | 47.1                                   | 32.5  | 79                         | 0                                     |
| Texas Co.        | 17,990          | 20,924          | 2,934                   | 16                        | 33.8                                   | 37.3                                   | 5.5   | 10                         | 100                                   |
| Tillman Co.      | 12,063          | 7,399           | -4,664                  | -39                       | 12.3                                   | 12.6                                   | 0.5   | 2                          | 0                                     |

| Oklahoma County         | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Tulsa Co.               | 497,599          | 646,437          | 148,838                 | 30                        | 111.8                                  | 175.2                                  | 99.1  | 57                         | 58                                    |
| Wagoner Co.             | 44,931           | 78,984           | 34,053                  | 76                        | 20.8                                   | 35.2                                   | 22.5  | 69                         | 100                                   |
| Washington Co.          | 52,988           | 51,996           | -992                    | -2                        | 13.5                                   | 22.9                                   | 14.7  | 70                         | 0                                     |
| Washita Co.             | 17,855           | 11,055           | -6,800                  | -38                       | 22.5                                   | 25.5                                   | 4.7   | 13                         | 0                                     |
| Woods Co.               | 11,000           | 9,069            | -1,931                  | -18                       | 20.0                                   | 22.8                                   | 4.4   | 14                         | 0                                     |
| Woodward Co.            | 25,084           | 20,531           | -4,553                  | -18                       | 20.4                                   | 26.0                                   | 8.8   | 27                         | 0                                     |
| <b>Totals</b>           | <b>3,206,129</b> | <b>3,931,316</b> | <b>725,187</b>          | <b>23</b>                 | <b>1,485.0</b>                         | <b>2,210.4</b>                         | <b>1,133.4</b>                                    | <b>49</b>                  | <b>51</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>41</b>                             |



**Scatter Plot for Oklahoma County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.96**

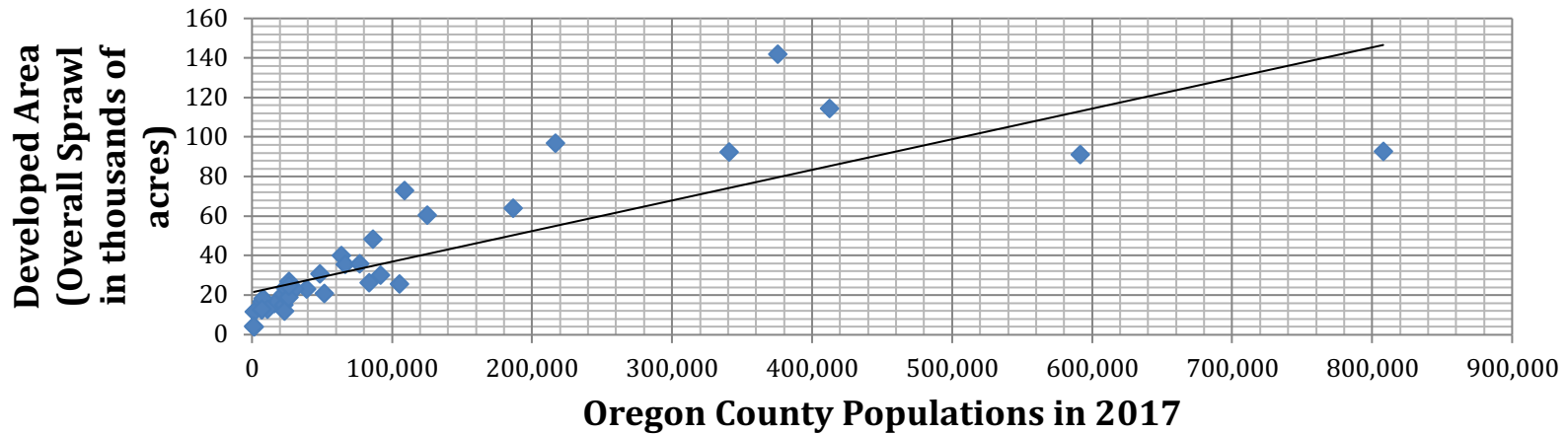
**Oregon**

| <b>Oregon County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Baker Co.            | 16,377                 | 16,083                 | -294                           | -2                               | 14.8  | 15.6  | 1.3  | 5                                 | 0  |
| Benton Co.           | 69,461                 | 91,790                 | 22,329                         | 32                               | 24.4  | 30.2  | 9.1  | 24                                | 100  |
| Clackamas Co.        | 247,804                | 412,442                | 164,638                        | 66                               | 70.4  | 114.3   | 68.6   | 62                                | 100  |
| Clatsop Co.          | 32,543                 | 39,101                 | 6,558                          | 20                               | 18.4  | 23.2  | 7.5  | 26                                | 79   |
| Columbia Co.         | 36,170                 | 51,724                 | 15,554                         | 43                               | 13.9  | 20.9  | 10.9   | 50                                | 88   |
| Coos Co.             | 61,774                 | 63,708                 | 1,934                          | 3                                | 27.5  | 40.0  | 19.5   | 45                                | 8  |
| Crook Co.            | 12,946                 | 23,065                 | 10,119                         | 78                               | 10.7  | 15.1  | 6.9  | 41                                | 100  |
| Curry Co.            | 17,413                 | 22,630                 | 5,217                          | 30                               | 15.1  | 20.6  | 8.6  | 36                                | 84   |
| Deschutes Co.        | 63,031                 | 186,744                | 123,713                        | 196                              | 23.5  | 63.9  | 63.1   | 172                               | 100  |
| Douglas Co.          | 91,740                 | 109,197                | 17,457                         | 19                               | 57.5  | 72.8  | 23.9   | 27                                | 74   |
| Gilliam Co.          | 2,001                  | 1,862                  | -139                           | -7                               | 7.0   | 11.6  | 7.2  | 66                                | 0  |

| Oregon County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Grant Co.      | 7,979           | 7,188           | -791                    | -10                       | 9.7                                    | 12.6                                   | 4.5   | 30                         | 0                                     |
| Harney Co.     | 7,469           | 7,258           | -211                    | -3                        | 14.6                                   | 16.7                                   | 3.3   | 14                         | 0                                     |
| Hood River Co. | 16,080          | 23,398          | 7,318                   | 46                        | 8.7                                    | 11.9                                   | 5.0   | 37                         | 100                                   |
| Jackson Co.    | 133,847         | 216,746         | 82,899                  | 62                        | 71.4                                   | 96.9                                   | 39.8  | 36                         | 100                                   |
| Jefferson Co.  | 12,305          | 23,652          | 11,347                  | 92                        | 12.8                                   | 23.8                                   | 17.2  | 86                         | 100                                   |
| Josephine Co.  | 58,154          | 86,584          | 28,430                  | 49                        | 26.1                                   | 48.2                                   | 34.5  | 85                         | 65                                    |
| Klamath Co.    | 59,035          | 66,810          | 7,775                   | 13                        | 27.1                                   | 35.6                                   | 13.3  | 31                         | 45                                    |
| Lake Co.       | 7,782           | 7,874           | 92                      | 1                         | 15.7                                   | 18.3                                   | 4.1   | 17                         | 8                                     |
| Lane Co.       | 272,346         | 375,264         | 102,918                 | 38                        | 110.7                                  | 141.7                                  | 48.4  | 28                         | 100                                   |
| Lincoln Co.    | 36,364          | 48,757          | 12,393                  | 34                        | 22.4                                   | 30.6                                   | 12.8  | 37                         | 94                                    |
| Linn Co.       | 89,748          | 125,035         | 35,287                  | 39                        | 40.2                                   | 60.5                                   | 31.7  | 50                         | 81                                    |
| Malheur Co.    | 27,641          | 30,385          | 2,744                   | 10                        | 17.1                                   | 23.1                                   | 9.4   | 35                         | 31                                    |

| Oregon County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Marion Co.     | 209,186         | 340,531         | 131,345                 | 63                        | 58.2                                   | 92.3                                   | 53.3  | 59                         | 100                                   |
| Morrow Co.     | 7,519           | 11,198          | 3,679                   | 49                        | 8.7                                    | 12.7                                   | 6.3   | 46                         | 100                                   |
| Multnomah Co.  | 565,189         | 807,885         | 242,696                 | 43                        | 70.7                                   | 92.5                                   | 34.1  | 31                         | 100                                   |
| Polk Co.       | 45,664          | 83,711          | 38,047                  | 83                        | 17.4                                   | 26.2                                   | 13.8  | 51                         | 100                                   |
| Sherman Co.    | 2,152           | 1,735           | -417                    | -19                       | 3.6                                    | 3.8                                    | 0.3   | 6                          | 0                                     |
| Tillamook Co.  | 21,653          | 26,522          | 4,869                   | 22                        | 18.1                                   | 26.9                                   | 13.8  | 49                         | 51                                    |
| Umatilla Co.   | 60,227          | 77,120          | 16,893                  | 28                        | 21.6                                   | 35.8                                   | 22.2  | 66                         | 49                                    |
| Union Co.      | 24,536          | 26,383          | 1,847                   | 8                         | 13.5                                   | 18.9                                   | 8.4   | 40                         | 22                                    |
| Wallowa Co.    | 7,412           | 7,025           | -387                    | -5                        | 10.5                                   | 12.8                                   | 3.6   | 22                         | 0                                     |
| Wasco Co.      | 22,767          | 26,296          | 3,529                   | 16                        | 19.2                                   | 24.7                                   | 8.6   | 29                         | 57                                    |
| Washington Co. | 259,720         | 591,336         | 331,616                 | 128                       | 52.9                                   | 90.9                                   | 59.4  | 72                         | 100                                   |
| Wheeler Co.    | 1,473           | 1,348           | -125                    | -8                        | 3.9                                    | 4.1                                    | 0.3   | 5                          | 0                                     |

| Oregon County           | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Yamhill Co.             | 57,411           | 105,238          | 47,827                  | 83                        | 17.4                                   | 25.7                                   | 13.0  | 48                         | 100                                   |
| <b>Totals</b>           | <b>2,664,919</b> | <b>4,143,625</b> | <b>1,478,706</b>        | <b>55</b>                 | <b>975.4</b>                           | <b>1,415.4</b>                         | <b>687.5</b>                                      | <b>45</b>                  | <b>100</b>                            |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>83</b>                             |



**Scatter Plot for Oregon County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.81**

**Pennsylvania**

| <b>Pennsylvania County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adams Co.                  | 70,422                 | 102,562                | 32,140                         | 46                               | 25.4  | 53.1  | 43.3   | 109                               | 51   |
| Allegheny Co.              | 1,429,717              | 1,220,141              | -209,576                       | -15                              | 223.1   | 298.3   | 117.5  | 34                                | 0  |
| Armstrong Co.              | 77,298                 | 65,991                 | -11,307                        | -15                              | 22.6  | 45.4  | 35.6   | 101                               | 0  |
| Beaver Co.                 | 201,308                | 165,654                | -35,654                        | -18                              | 56.8  | 88.2  | 49.1   | 55                                | 0  |
| Bedford Co.                | 47,381                 | 48,356                 | 975                            | 2                                | 25.0  | 35.7  | 16.7   | 43                                | 6  |
| Berks Co.                  | 314,597                | 417,511                | 102,914                        | 33                               | 76.9  | 132.3   | 86.6   | 72                                | 52   |
| Blair Co.                  | 135,600                | 123,147                | -12,453                        | -9                               | 29.4  | 46.3  | 26.4   | 57                                | 0  |
| Bradford Co.               | 63,088                 | 60,963                 | -2,125                         | -3                               | 23.1  | 41.6  | 28.9   | 80                                | 0  |
| Bucks Co.                  | 492,855                | 626,811                | 133,956                        | 27                               | 130.2   | 176.1   | 71.7   | 35                                | 80   |
| Butler Co.                 | 148,899                | 186,828                | 37,929                         | 25                               | 65.3  | 104.4   | 61.1   | 60                                | 48   |
| Cambria Co.                | 178,601                | 132,960                | -45,641                        | -26                              | 44.3  | 67.6  | 36.4   | 53                                | 0  |

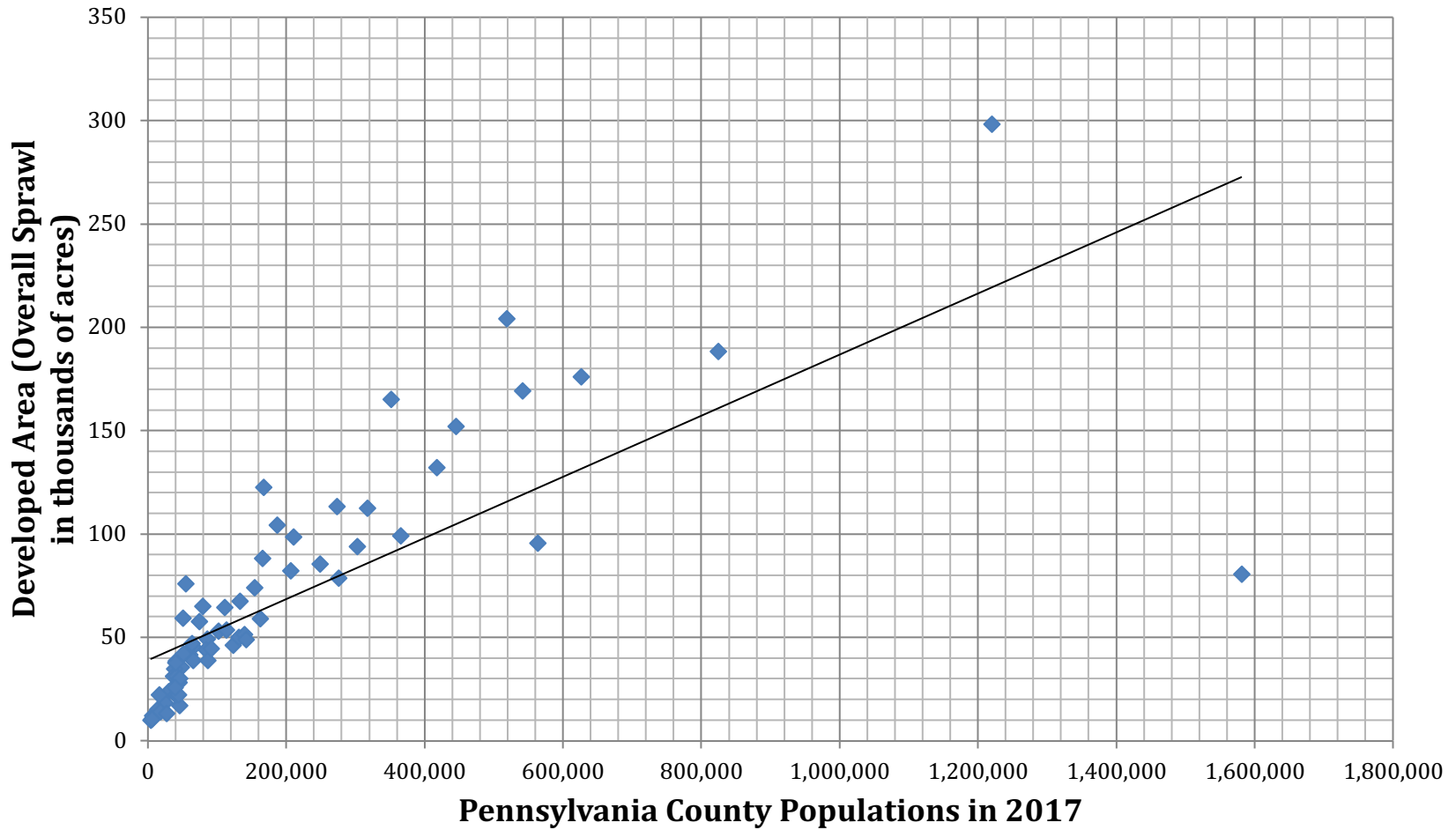
| <b>Pennsylvania County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Cameron Co.                | 6,736                  | 4,619                  | -2,117                         | -31                              | 6.0   | 10.0  | 6.3  | 67                                | 0  |
| Carbon Co.                 | 53,913                 | 63,828                 | 9,915                          | 18                               | 22.8  | 47.0  | 37.8   | 106                               | 23   |
| Centre Co.                 | 114,706                | 162,316                | 47,610                         | 42                               | 35.3  | 59.0  | 37.0   | 67                                | 68   |
| Chester Co.                | 325,773                | 518,901                | 193,128                        | 59                               | 113.0   | 204.3   | 142.7  | 81                                | 79   |
| Clarion Co.                | 43,306                 | 38,998                 | -4,308                         | -10                              | 25.4  | 34.8  | 14.7   | 37                                | 0  |
| Clearfield Co.             | 82,433                 | 79,799                 | -2,634                         | -3                               | 39.3  | 65.0  | 40.2   | 65                                | 0  |
| Clinton Co.                | 38,450                 | 38,830                 | 380                            | 1                                | 15.3  | 23.6  | 13.0   | 54                                | 2  |
| Columbia Co.               | 62,238                 | 65,581                 | 3,343                          | 5                                | 22.2  | 38.9  | 26.1   | 75                                | 9  |
| Crawford Co.               | 90,069                 | 85,772                 | -4,297                         | -5                               | 36.8  | 49.2  | 19.4   | 34                                | 0  |
| Cumberland Co.             | 181,377                | 249,024                | 67,647                         | 37                               | 40.0  | 85.7  | 71.4   | 114                               | 42   |
| Dauphin Co.                | 233,019                | 275,714                | 42,695                         | 18                               | 52.7  | 78.7  | 40.6   | 49                                | 42   |
| Delaware Co.               | 549,427                | 563,858                | 14,431                         | 3                                | 78.3  | 95.7  | 27.2   | 22                                | 13   |

| <b>Pennsylvania County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Elk Co.                    | 37,698                 | 30,271                 | -7,427                         | -20                              | 11.5  | 23.9  | 19.4   | 108                               | 0  |
| Erie Co.                   | 281,320                | 273,558                | -7,762                         | -3                               | 70.8  | 113.3   | 66.4   | 60                                | 0  |
| Fayette Co.                | 156,595                | 131,309                | -25,286                        | -16                              | 31.0  | 50.1  | 29.8   | 62                                | 0  |
| Forest Co.                 | 4,994                  | 7,317                  | 2,323                          | 47                               | 7.8   | 12.2  | 6.9  | 56                                | 85   |
| Franklin Co.               | 114,688                | 154,376                | 39,688                         | 35                               | 41.4  | 74.0  | 50.9   | 79                                | 51   |
| Fulton Co.                 | 12,879                 | 14,469                 | 1,590                          | 12                               | 10.9  | 15.1  | 6.6  | 39                                | 36   |
| Greene Co.                 | 40,760                 | 36,846                 | -3,914                         | -10                              | 19.5  | 31.2  | 18.3   | 60                                | 0  |
| Huntingdon Co.             | 42,807                 | 45,429                 | 2,622                          | 6                                | 13.9  | 28.3  | 22.5   | 104                               | 8  |
| Indiana Co.                | 92,516                 | 84,743                 | -7,773                         | -8                               | 20.9  | 44.1  | 36.3   | 111                               | 0  |
| Jefferson Co.              | 48,251                 | 43,818                 | -4,433                         | -9                               | 19.8  | 28.0  | 12.8   | 41                                | 0  |
| Juniata Co.                | 19,400                 | 24,635                 | 5,235                          | 27                               | 7.5   | 18.4  | 17.0   | 145                               | 27   |
| Lackawanna Co.             | 225,401                | 210,451                | -14,950                        | -7                               | 63.9  | 98.7  | 54.4   | 54                                | 0  |

| <b>Pennsylvania County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Lancaster Co.              | 370,992                | 541,332                | 170,340                        | 46                               | 108.5   | 169.4   | 95.2   | 56                                | 85   |
| Lawrence Co.               | 105,246                | 86,546                 | -18,700                        | -18                              | 23.0  | 39.0  | 25.0   | 70                                | 0  |
| Lebanon Co.                | 110,574                | 139,553                | 28,979                         | 26                               | 27.8  | 51.5  | 37.0   | 85                                | 38   |
| Lehigh Co.                 | 274,582                | 365,577                | 90,995                         | 33                               | 60.9  | 99.1  | 59.7   | 63                                | 59   |
| Luzerne Co.                | 339,054                | 317,808                | -21,246                        | -6                               | 70.5  | 112.7   | 65.9   | 60                                | 0  |
| Lycoming Co.               | 117,354                | 114,012                | -3,342                         | -3                               | 30.0  | 53.6  | 36.9   | 79                                | 0  |
| McKean Co.                 | 50,385                 | 41,362                 | -9,023                         | -18                              | 21.2  | 31.3  | 15.8   | 48                                | 0  |
| Mercer Co.                 | 127,173                | 111,473                | -15,700                        | -12                              | 41.4  | 64.6  | 36.3   | 56                                | 0  |
| Mifflin Co.                | 46,452                 | 46,290                 | -162                           | 0                                | 10.8  | 17.1  | 9.8  | 58                                | 0  |
| Monroe Co.                 | 71,688                 | 167,895                | 96,207                         | 134                              | 61.0  | 122.6   | 96.3   | 101                               | 100  |
| Montgomery Co.             | 647,181                | 824,303                | 177,122                        | 27                               | 122.9   | 188.4   | 102.3  | 53                                | 57   |
| Montour Co.                | 16,985                 | 18,270                 | 1,285                          | 8                                | 10.1  | 14.1  | 6.3  | 40                                | 22   |

| <b>Pennsylvania County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Northampton Co.            | 227,008                | 302,801                | 75,793                         | 33                               | 47.7  | 94.0  | 72.3   | 97                                | 42   |
| Northumberland Co.         | 100,048                | 91,721                 | -8,327                         | -8                               | 27.1  | 44.7  | 27.5   | 65                                | 0  |
| Perry Co.                  | 36,545                 | 46,046                 | 9,501                          | 26                               | 12.7  | 30.2  | 27.3   | 138                               | 27   |
| Philadelphia Co.           | 1,658,843              | 1,580,601              | -78,242                        | -5                               | 78.3  | 80.7  | 3.8  | 3                                 | 0  |
| Pike Co.                   | 19,018                 | 55,397                 | 36,379                         | 191                              | 39.8  | 76.1  | 56.7   | 91                                | 100  |
| Potter Co.                 | 17,557                 | 16,841                 | -716                           | -4                               | 14.8  | 22.4  | 11.9   | 51                                | 0  |
| Schuylkill Co.             | 158,198                | 142,580                | -15,618                        | -10                              | 28.1  | 49.1  | 32.8   | 75                                | 0  |
| Snyder Co.                 | 34,421                 | 40,594                 | 6,173                          | 18                               | 12.2  | 22.2  | 15.6   | 82                                | 28   |
| Somerset Co.               | 81,105                 | 74,242                 | -6,863                         | -8                               | 36.4  | 57.9  | 33.6   | 59                                | 0  |
| Sullivan Co.               | 6,240                  | 6,142                  | -98                            | -2                               | 5.5   | 10.6  | 8.0  | 93                                | 0  |
| Susquehanna Co.            | 37,788                 | 40,934                 | 3,146                          | 8                                | 20.5  | 38.8  | 28.6   | 89                                | 13   |

| <b>Pennsylvania County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Tioga Co.                  | 41,158                 | 40,671                 | -487                           | -1                               | 24.4  | 37.9  | 21.1   | 55                                | 0  |
| Union Co.                  | 33,412                 | 44,642                 | 11,230                         | 34                               | 11.1  | 22.2  | 17.3   | 100                               | 42   |
| Venango Co.                | 64,923                 | 51,790                 | -13,133                        | -20                              | 30.0  | 42.3  | 19.2   | 41                                | 0  |
| Warren Co.                 | 48,066                 | 39,679                 | -8,387                         | -17                              | 17.2  | 25.8  | 13.4   | 50                                | 0  |
| Washington Co.             | 216,305                | 207,075                | -9,230                         | -4                               | 46.6  | 82.3  | 55.8   | 77                                | 0  |
| Wayne Co.                  | 35,512                 | 51,192                 | 15,680                         | 44                               | 37.4  | 59.3  | 34.2   | 59                                | 79   |
| Westmoreland Co.           | 390,190                | 352,006                | -38,184                        | -10                              | 96.2  | 165.1   | 107.7  | 72                                | 0  |
| Wyoming Co.                | 26,649                 | 27,396                 | 747                            | 3                                | 8.0   | 13.3  | 8.3  | 66                                | 5  |
| York Co.                   | 315,972                | 445,484                | 129,512                        | 41                               | 79.1  | 152.1   | 114.1  | 92                                | 53   |
| <b>Totals</b>              | <b>11,845,146</b>      | <b>12,787,641</b>      | <b>942,495</b>                 | <b>8</b>                         | <b>2,789.3</b>                                | <b>4,508.6</b>                                | <b>2,686.4</b>   | <b>62</b>                         | <b>16</b>                                    |
| <b>Weighted Average</b>    |                        |                        |                                |                                  |   |   |  |                                   | <b>33</b>                                    |

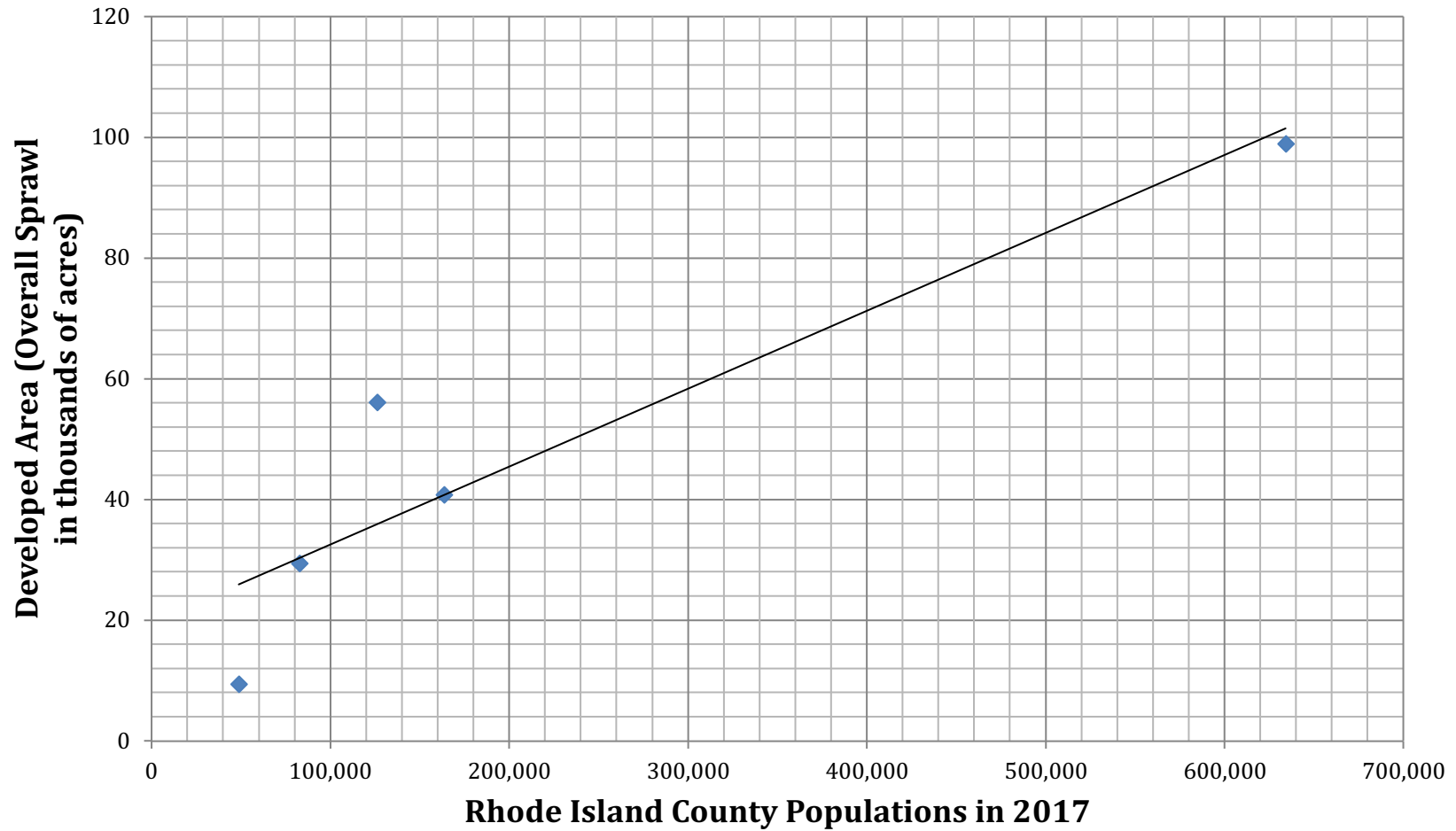


**Scatter Plot for Pennsylvania County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.75**

**Rhode Island**

| <b>Rhode Island County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Bristol Co.                | 46,487                 | 48,734                 | 2,247                          | 5                                | 8.5   | 9.4   | 1.4  | 11                                | 47   |
| Kent Co.                   | 153,908                | 163,543                | 9,635                          | 6                                | 30.4  | 40.8  | 16.3   | 34                                | 21   |
| Newport Co.                | 83,293                 | 82,952                 | -341                           | 0                                | 21.0  | 29.4  | 13.1   | 40                                | 0  |
| Providence Co.             | 575,016                | 634,130                | 59,114                         | 10                               | 79.5  | 98.9  | 30.3   | 24                                | 45   |
| Washington Co.             | 95,466                 | 126,314                | 30,848                         | 32                               | 31.8  | 56.1  | 38.0   | 76                                | 49   |
| <b>Totals</b>              | <b>954,170</b>         | <b>1,055,673</b>       | <b>101,503</b>                 | <b>11</b>                        | <b>171.2</b>                                  | <b>234.6</b>                                  | <b>99.1</b>  | <b>37</b>                         | <b>32</b>                                    |
| <b>Weighted Average</b>    |                        |                        |                                |                                  |   |   |  |                                   | <b>37</b>                                    |



**Scatter Plot for Rhode Island County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.92**

**South Carolina**

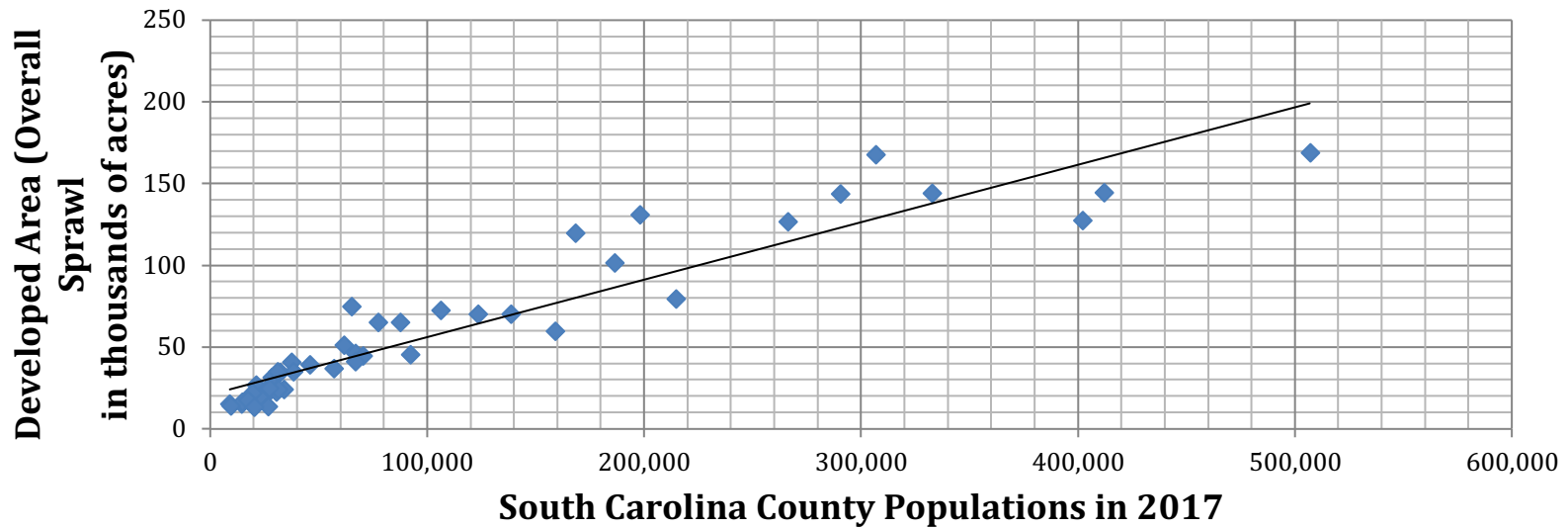
| <b>South Carolina County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Abbeville Co.                | 22,964                 | 24,567                 | 1,603                          | 7                                | 13.3  | 19.5  | 9.7  | 47                                | 18   |
| Aiken Co.                    | 108,220                | 168,325                | 60,105                         | 56                               | 64.8  | 119.8   | 85.9   | 85                                | 72   |
| Allendale Co.                | 10,641                 | 9,012                  | -1,629                         | -15                              | 10.4  | 15.3  | 7.7  | 47                                | 0  |
| Anderson Co.                 | 136,853                | 198,186                | 61,333                         | 45                               | 77.6  | 130.9   | 83.3   | 69                                | 71   |
| Bamberg Co.                  | 17,965                 | 14,384                 | -3,581                         | -20                              | 9.9   | 15.3  | 8.4  | 55                                | 0  |
| Barnwell Co.                 | 19,731                 | 21,355                 | 1,624                          | 8                                | 13.9  | 26.9  | 20.3   | 94                                | 12   |
| Beaufort Co.                 | 71,141                 | 186,497                | 115,356                        | 162                              | 23.8  | 101.6   | 121.6  | 327                               | 66   |
| Berkeley Co.                 | 103,027                | 214,541                | 111,514                        | 108                              | 35.6  | 79.7  | 68.9   | 124                               | 91   |
| Calhoun Co.                  | 11,852                 | 14,696                 | 2,844                          | 24                               | 8.8   | 16.6  | 12.2   | 89                                | 34   |
| Charleston Co.               | 285,827                | 402,008                | 116,181                        | 41                               | 69.8  | 127.7   | 90.5   | 83                                | 56   |
| Cherokee Co.                 | 41,368                 | 56,913                 | 15,545                         | 38                               | 19.4  | 37.0  | 27.5   | 91                                | 49   |

| South Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Chester Co.           | 31,122          | 32,299          | 1,177                   | 4                         | 21.8                                   | 34.8                                   | 20.3  | 60                         | 8                                     |
| Chesterfield Co.      | 38,233          | 45,979          | 7,746                   | 20                        | 22.8                                   | 39.4                                   | 25.9  | 73                         | 34                                    |
| Clarendon Co.         | 27,834          | 34,012          | 6,178                   | 22                        | 12.3                                   | 24.3                                   | 18.8  | 98                         | 29                                    |
| Colleton Co.          | 32,129          | 37,555          | 5,426                   | 17                        | 21.3                                   | 41.0                                   | 30.8  | 92                         | 24                                    |
| Darlington Co.        | 62,995          | 66,981          | 3,986                   | 6                         | 23.7                                   | 46.3                                   | 35.3  | 95                         | 9                                     |
| Dillon Co.            | 31,068          | 30,496          | -572                    | -2                        | 14.7                                   | 22.7                                   | 12.5  | 54                         | 0                                     |
| Dorchester Co.        | 64,444          | 158,988         | 94,544                  | 147                       | 24.0                                   | 59.9                                   | 56.1  | 150                        | 99                                    |
| Edgefield Co.         | 17,745          | 26,837          | 9,092                   | 51                        | 8.3                                    | 13.6                                   | 8.3   | 64                         | 84                                    |
| Fairfield Co.         | 20,671          | 22,593          | 1,922                   | 9                         | 16.0                                   | 19.7                                   | 5.8   | 23                         | 43                                    |
| Florence Co.          | 111,406         | 138,495         | 27,089                  | 24                        | 39.9                                   | 70.2                                   | 47.3  | 76                         | 39                                    |
| Georgetown Co.        | 43,053          | 61,826          | 18,773                  | 44                        | 28.2                                   | 51.2                                   | 35.9  | 82                         | 61                                    |
| Greenville Co.        | 295,615         | 506,831         | 211,216                 | 71                        | 87.1                                   | 168.8                                  | 127.7   | 94                         | 81                                    |

| South Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Greenwood Co.         | 57,563          | 70,496          | 12,933                  | 22                        | 25.9                                   | 44.5                                   | 29.1  | 72                         | 37                                    |
| Hampton Co.           | 18,419          | 19,498          | 1,079                   | 6                         | 14.2                                   | 22.0                                   | 12.2  | 55                         | 13                                    |
| Horry Co.             | 109,274         | 332,655         | 223,381                 | 204                       | 58.2                                   | 144.2                                  | 134.4   | 148                        | 100                                   |
| Jasper Co.            | 14,386          | 28,522          | 14,136                  | 98                        | 13.6                                   | 31.7                                   | 28.3  | 133                        | 81                                    |
| Kershaw Co.           | 39,846          | 65,213          | 25,367                  | 64                        | 26.3                                   | 74.9                                   | 75.9  | 185                        | 47                                    |
| Lancaster Co.         | 54,088          | 92,411          | 38,323                  | 71                        | 18.9                                   | 45.4                                   | 41.4  | 140                        | 61                                    |
| Laurens Co.           | 53,391          | 66,822          | 13,431                  | 25                        | 25.3                                   | 41.2                                   | 24.8  | 63                         | 46                                    |
| Lee Co.               | 18,525          | 17,388          | -1,137                  | -6                        | 9.8                                    | 17.6                                   | 12.2  | 80                         | 0                                     |
| Lexington Co.         | 145,414         | 290,338         | 144,924                 | 100                       | 56.1                                   | 143.7                                  | 136.9   | 156                        | 74                                    |
| McCormick Co.         | 7,413           | 9,554           | 2,141                   | 29                        | 8.7                                    | 14.3                                   | 8.8   | 64                         | 51                                    |
| Marion Co.            | 34,284          | 31,295          | -2,989                  | -9                        | 14.7                                   | 24.2                                   | 14.8  | 65                         | 0                                     |
| Marlboro Co.          | 31,822          | 26,691          | -5,131                  | -16                       | 15.6                                   | 25.3                                   | 15.2  | 62                         | 0                                     |

| South Carolina County | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Newberry Co.          | 32,069           | 38,381           | 6,312                   | 20                        | 18.6                                   | 35.1                                   | 25.8  | 89                         | 28                                    |
| Oconee Co.            | 50,425           | 77,388           | 26,963                  | 53                        | 34.4                                   | 65.2                                   | 48.1  | 90                         | 67                                    |
| Orangeburg Co.        | 82,909           | 87,671           | 4,762                   | 6                         | 30.8                                   | 65.3                                   | 53.9  | 112                        | 7                                     |
| Pickens Co.           | 82,920           | 123,518          | 40,598                  | 49                        | 38.3                                   | 70.4                                   | 50.2  | 84                         | 65                                    |
| Richland Co.          | 273,620          | 411,800          | 138,180                 | 51                        | 73.6                                   | 144.6                                  | 110.9   | 96                         | 61                                    |
| Saluda Co.            | 16,212           | 20,299           | 4,087                   | 25                        | 7.7                                    | 13.3                                   | 8.8   | 73                         | 41                                    |
| Spartanburg Co.       | 207,456          | 306,740          | 99,284                  | 48                        | 80.5                                   | 167.9                                  | 136.6   | 109                        | 53                                    |
| Sumter Co.            | 91,845           | 106,431          | 14,586                  | 16                        | 44.5                                   | 72.4                                   | 43.6  | 63                         | 30                                    |
| Union Co.             | 30,969           | 27,400           | -3,569                  | -12                       | 14.2                                   | 24.8                                   | 16.6  | 75                         | 0                                     |
| Williamsburg Co.      | 37,736           | 31,216           | -6,520                  | -17                       | 21.0                                   | 35.1                                   | 22.0  | 67                         | 0                                     |
| York Co.              | 111,121          | 266,165          | 155,044                 | 140                       | 47.0                                   | 126.8                                  | 124.7   | 170                        | 88                                    |
| <b>Totals</b>         | <b>3,207,611</b> | <b>5,021,268</b> | <b>1,813,657</b>        | <b>57</b>                 | <b>1,365.3</b>                         | <b>2,732.1</b>                         | <b>2,135.6</b>                                    | <b>100</b>                 | <b>65</b>                             |

| South Carolina County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Weighted Average      |                 |                 |                         |                           |  |  |   |                            | 59                                    |



**Scatter Plot for South County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.94**

**South Dakota**

| <b>South Dakota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Aurora Co.                 | 3,551                  | 2,769                  | -782                           | -22                              | 9.0   | 9.7   | 1.1  | 8                                 | 0  |
| Beadle Co.                 | 19,088                 | 18,541                 | -547                           | -3                               | 24.1  | 27.0  | 4.5  | 12                                | 0  |
| Bennett Co.                | 3,089                  | 3,446                  | 357                            | 12                               | 7.4   | 6.9   | -0.8   | -7                                | 0  |
| Bon Homme Co.              | 7,822                  | 6,952                  | -870                           | -11                              | 11.2  | 12.0  | 1.3  | 7                                 | 0  |
| Brookings Co.              | 24,958                 | 34,749                 | 9,791                          | 39                               | 17.7  | 20.4  | 4.2  | 15                                | 100  |
| Brown Co.                  | 37,045                 | 39,290                 | 2,245                          | 6                                | 39.3  | 46.2  | 10.8   | 18                                | 36   |
| Brule Co.                  | 5,406                  | 5,304                  | -102                           | -2                               | 10.8  | 12.0  | 1.9  | 11                                | 0  |
| Buffalo Co.                | 1,685                  | 2,013                  | 328                            | 19                               | 3.4   | 3.3   | -0.2   | -3                                | 0  |
| Butte Co.                  | 8,230                  | 10,114                 | 1,884                          | 23                               | 7.7   | 8.9   | 1.9  | 16                                | 100  |
| Campbell Co.               | 2,193                  | 1,372                  | -821                           | -37                              | 7.8   | 7.9   | 0.2  | 1                                 | 0  |
| Charles Mix Co.            | 9,665                  | 9,404                  | -261                           | -3                               | 14.5  | 14.9  | 0.6  | 3                                 | 0  |

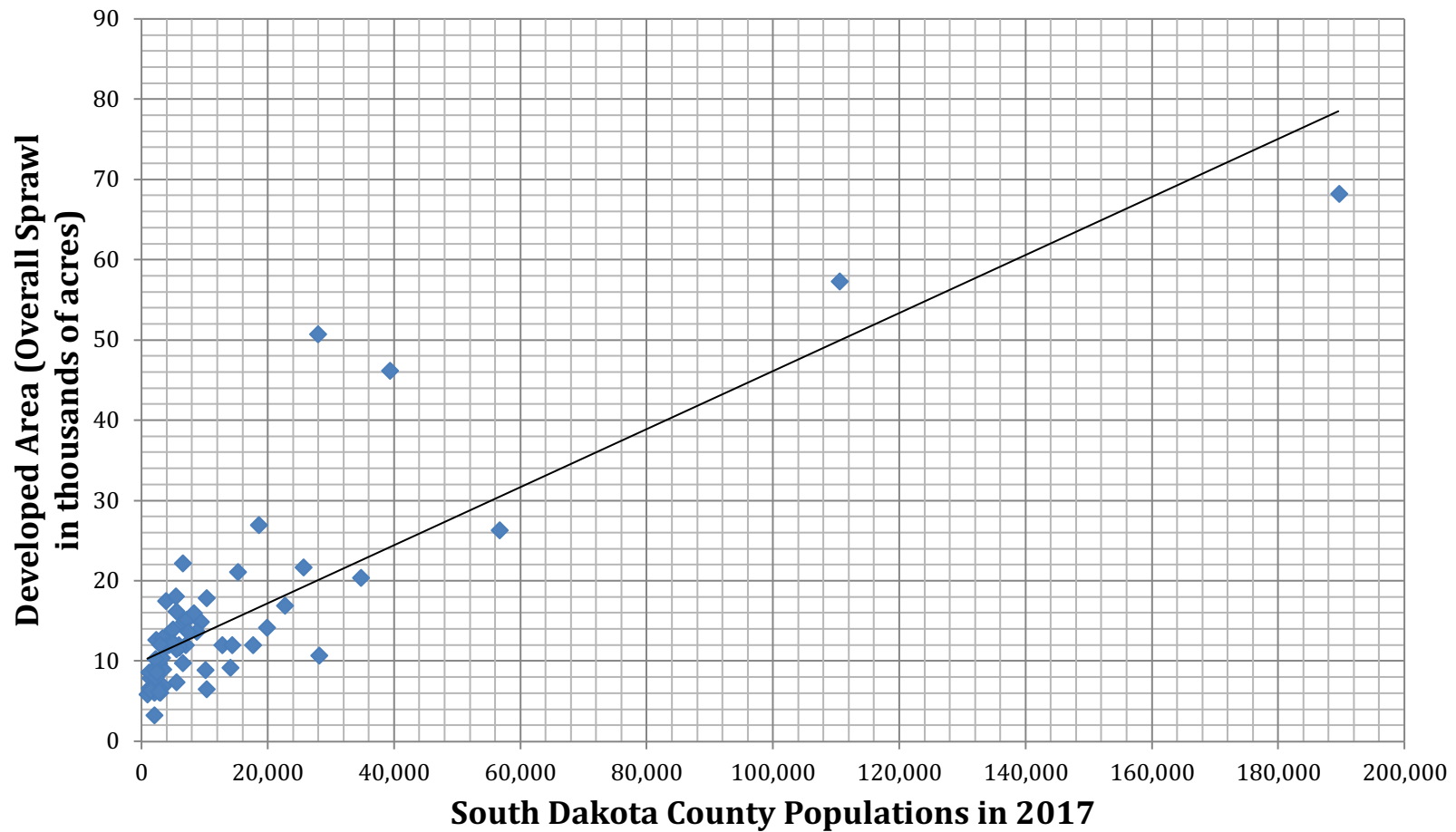
| South Dakota County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Clark Co.           | 4,790           | 3,679           | -1,111                  | -23                       | 11.4                                   | 11.7                                   | 0.5   | 3                          | 0                                     |
| Clay Co.            | 13,786          | 14,032          | 246                     | 2                         | 7.0                                    | 9.2                                    | 3.4   | 31                         | 6                                     |
| Codington Co.       | 21,480          | 28,125          | 6,645                   | 31                        | 9.5                                    | 10.7                                   | 1.9   | 13                         | 100                                   |
| Corson Co.          | 5,115           | 4,195           | -920                    | -18                       | 13.3                                   | 13.4                                   | 0.2   | 1                          | 0                                     |
| Custer Co.          | 6,128           | 8,763           | 2,635                   | 43                        | 12.2                                   | 13.7                                   | 2.3   | 12                         | 100                                   |
| Davison Co.         | 17,717          | 19,870          | 2,153                   | 12                        | 11.3                                   | 14.2                                   | 4.5   | 26                         | 50                                    |
| Day Co.             | 7,941           | 5,494           | -2,447                  | -31                       | 15.7                                   | 16.2                                   | 0.8   | 3                          | 0                                     |
| Deuel Co.           | 5,209           | 4,311           | -898                    | -17                       | 11.1                                   | 12.0                                   | 1.4   | 8                          | 0                                     |
| Dewey Co.           | 5,333           | 5,857           | 524                     | 10                        | 11.2                                   | 12.0                                   | 1.3   | 7                          | 100                                   |
| Douglas Co.         | 4,039           | 2,927           | -1,112                  | -28                       | 5.9                                    | 6.5                                    | 0.9   | 10                         | 0                                     |
| Edmunds Co.         | 4,915           | 3,915           | -1,000                  | -20                       | 15.8                                   | 17.5                                   | 2.7   | 11                         | 0                                     |
| Fall River Co.      | 8,022           | 6,698           | -1,324                  | -17                       | 12.1                                   | 14.9                                   | 4.4   | 23                         | 0                                     |

| South Dakota County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Faulk Co.           | 3,281           | 2,323           | -958                    | -29                       | 12.4                                   | 12.7                                   | 0.5   | 2                          | 0                                     |
| Grant Co.           | 9,090           | 7,159           | -1,931                  | -21                       | 13.5                                   | 15.2                                   | 2.7   | 13                         | 0                                     |
| Gregory Co.         | 5,884           | 4,206           | -1,678                  | -29                       | 11.3                                   | 12.4                                   | 1.7   | 10                         | 0                                     |
| Haakon Co.          | 2,833           | 1,921           | -912                    | -32                       | 8.0                                    | 8.4                                    | 0.6   | 5                          | 0                                     |
| Hamlin Co.          | 5,184           | 5,998           | 814                     | 16                        | 11.1                                   | 11.7                                   | 0.9   | 5                          | 100                                   |
| Hand Co.            | 4,756           | 3,275           | -1,481                  | -31                       | 12.1                                   | 12.9                                   | 1.3   | 7                          | 0                                     |
| Hanson Co.          | 3,320           | 3,409           | 89                      | 3                         | 7.4                                    | 9.0                                    | 2.5   | 22                         | 14                                    |
| Harding Co.         | 1,670           | 1,244           | -426                    | -26                       | 9.0                                    | 8.6                                    | -0.6  | -4                         | 100                                   |
| Hughes Co.          | 14,312          | 17,670          | 3,358                   | 23                        | 10.1                                   | 12.0                                   | 3.0   | 19                         | 100                                   |
| Hutchinson Co.      | 9,218           | 7,349           | -1,869                  | -20                       | 12.8                                   | 13.7                                   | 1.4   | 7                          | 0                                     |
| Hyde Co.            | 1,947           | 1,297           | -650                    | -33                       | 6.5                                    | 6.7                                    | 0.3   | 3                          | 0                                     |
| Jackson Co.         | 3,180           | 3,269           | 89                      | 3                         | 9.9                                    | 10.4                                   | 0.8   | 5                          | 56                                    |

| South Dakota County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Jerauld Co.         | 2,840           | 2,024           | -816                    | -29                       | 6.0                                    | 6.1                                    | 0.2   | 2                          | 0                                     |
| Jones Co.           | 1,421           | 922             | -499                    | -35                       | 5.9                                    | 5.9                                    | 0.0   | 0                          | 0                                     |
| Kingsbury Co.       | 6,657           | 4,929           | -1,728                  | -26                       | 12.9                                   | 14.0                                   | 1.7   | 9                          | 0                                     |
| Lake Co.            | 10,871          | 12,795          | 1,924                   | 18                        | 10.3                                   | 12.0                                   | 2.7   | 17                         | 100                                   |
| Lawrence Co.        | 18,757          | 25,677          | 6,920                   | 37                        | 10.4                                   | 21.7                                   | 17.7  | 109                        | 43                                    |
| Lincoln Co.         | 13,952          | 56,681          | 42,729                  | 306                       | 15.5                                   | 26.3                                   | 16.9  | 70                         | 100                                   |
| Lyman Co.           | 3,783           | 3,876           | 93                      | 2                         | 10.3                                   | 11.9                                   | 2.5   | 16                         | 17                                    |
| McCook Co.          | 6,271           | 5,561           | -710                    | -11                       | 10.1                                   | 11.5                                   | 2.2   | 14                         | 0                                     |
| McPherson Co.       | 3,878           | 2,401           | -1,477                  | -38                       | 8.4                                    | 8.9                                    | 0.8   | 6                          | 0                                     |
| Marshall Co.        | 5,296           | 4,945           | -351                    | -7                        | 10.9                                   | 12.2                                   | 2.0   | 12                         | 0                                     |
| Meade Co.           | 20,479          | 27,941          | 7,462                   | 36                        | 26.4                                   | 50.7                                   | 38.0  | 92                         | 48                                    |
| Mellette Co.        | 2,238           | 2,063           | -175                    | -8                        | 6.8                                    | 8.9                                    | 3.3   | 31                         | 0                                     |

| <b>South Dakota County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|----------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Miner Co.                  | 3,618                  | 2,200                  | -1,418                         | -39                              | 7.7   | 8.0   | 0.5  | 4                                 | 0  |
| Minnehaha Co.              | 111,433                | 189,538                | 78,105                         | 70                               | 51.1  | 68.2  | 26.7   | 33                                | 100  |
| Moody Co.                  | 6,694                  | 6,494                  | -200                           | -3                               | 8.5   | 9.8   | 2.0  | 15                                | 0  |
| Ogalala Lakota Co.         | 10,806                 | 14,384                 | 3,578                          | 33                               | 9.7   | 12.0  | 3.6  | 24                                | 100  |
| Pennington Co.             | 72,268                 | 110,503                | 38,235                         | 53                               | 38.1  | 57.3  | 30.0   | 50                                | 100  |
| Perkins Co.                | 4,470                  | 2,962                  | -1,508                         | -34                              | 12.5  | 12.1  | -0.6   | -3                                | 0  |
| Potter Co.                 | 3,710                  | 2,214                  | -1,496                         | -40                              | 10.3  | 10.3  | 0.0  | 0                                 | 0  |
| Roberts Co.                | 10,806                 | 10,265                 | -541                           | -5                               | 16.5  | 17.9  | 2.2  | 8                                 | 0  |
| Sanborn Co.                | 3,146                  | 2,435                  | -711                           | -23                              | 7.8   | 8.6   | 1.3  | 10                                | 0  |
| Spink Co.                  | 9,022                  | 6,507                  | -2,515                         | -28                              | 20.9  | 22.2  | 2.0  | 6                                 | 0  |
| Stanley Co.                | 2,350                  | 2,986                  | 636                            | 27                               | 5.6   | 6.1   | 0.8  | 9                                 | 100  |

| South Dakota County     | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Sully Co.               | 1,925           | 1,398           | -527                    | -27                       | 5.8                                    | 6.4                                    | 0.9   | 10                         | 0                                     |
| Todd Co.                | 7,295           | 10,277          | 2,982                   | 41                        | 6.1                                    | 6.5                                    | 0.6   | 7                          | 100                                   |
| Tripp Co.               | 7,034           | 5,443           | -1,591                  | -23                       | 16.3                                   | 18.1                                   | 2.8   | 11                         | 0                                     |
| Turner Co.              | 9,091           | 8,303           | -788                    | -9                        | 14.5                                   | 16.0                                   | 2.3   | 10                         | 0                                     |
| Union Co.               | 10,800          | 15,277          | 4,477                   | 41                        | 11.2                                   | 21.1                                   | 15.5  | 88                         | 55                                    |
| Walworth Co.            | 6,740           | 5,497           | -1,243                  | -18                       | 6.8                                    | 7.4                                    | 0.9   | 9                          | 0                                     |
| Yankton Co.             | 18,831          | 22,682          | 3,851                   | 20                        | 12.5                                   | 16.9                                   | 6.9   | 35                         | 62                                    |
| Ziebach Co.             | 2,233           | 2,748           | 515                     | 23                        | 5.7                                    | 6.2                                    | 0.8   | 9                          | 100                                   |
| <b>Totals</b>           | <b>690,597</b>  | <b>872,868</b>  | <b>182,271</b>          | <b>26</b>                 | <b>815.0</b>                           | <b>976.1</b>                           | <b>251.7</b>                                      | <b>20</b>                  | 100                                   |
| <b>Weighted Average</b> |                 |                 |                         |                           |  |  |   |                            | <b>57</b>                             |



**Scatter Plot for South Dakota County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.85**

**Tennessee**

| <b>Tennessee County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Anderson Co.            | 67,762                 | 76,056                 | 8,294                          | 12                               | 22.3  | 45.9  | 36.9   | 106                               | 16   |
| Bedford Co.             | 28,360                 | 48,211                 | 19,851                         | 70                               | 12.9  | 20.0  | 11.1   | 55                                | 100  |
| Benton Co.              | 14,985                 | 15,993                 | 1,008                          | 7                                | 8.9   | 16.5  | 11.9   | 85                                | 11   |
| Bledsoe Co.             | 9,470                  | 14,895                 | 5,425                          | 57                               | 4.8   | 8.3   | 5.5  | 73                                | 83   |
| Blount Co.              | 79,403                 | 129,999                | 50,596                         | 64                               | 37.4  | 69.5  | 50.2   | 86                                | 80   |
| Bradley Co.             | 68,503                 | 105,421                | 36,918                         | 54                               | 22.7  | 45.8  | 36.1   | 102                               | 61   |
| Campbell Co.            | 35,343                 | 39,791                 | 4,448                          | 13                               | 17.2  | 33.0  | 24.7   | 92                                | 18   |
| Cannon Co.              | 10,432                 | 14,157                 | 3,725                          | 36                               | 3.4   | 7.9   | 7.0  | 132                               | 36   |
| Carroll Co.             | 28,138                 | 27,807                 | -331                           | -1                               | 12.6  | 20.0  | 11.6   | 59                                | 0  |
| Carter Co.              | 51,437                 | 56,510                 | 5,073                          | 10                               | 10.1  | 27.3  | 26.9   | 170                               | 9  |
| Cheatham Co.            | 21,796                 | 40,366                 | 18,570                         | 85                               | 10.1  | 24.0  | 21.7   | 138                               | 71   |

| Tennessee County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Chester Co.      | 12,616          | 17,154          | 4,538                   | 36                        | 6.3                                    | 11.6                                   | 8.3   | 84                         | 50                                    |
| Claiborne Co.    | 25,374          | 31,661          | 6,287                   | 25                        | 5.6                                    | 13.1                                   | 11.7  | 134                        | 26                                    |
| Clay Co.         | 7,564           | 7,663           | 99                      | 1                         | 7.0                                    | 8.8                                    | 2.8   | 26                         | 6                                     |
| Cocke Co.        | 29,116          | 35,528          | 6,412                   | 22                        | 10.5                                   | 22.1                                   | 18.1  | 110                        | 27                                    |
| Coffee Co.       | 39,543          | 55,016          | 15,473                  | 39                        | 16.5                                   | 27.7                                   | 17.5  | 68                         | 64                                    |
| Crockett Co.     | 14,093          | 14,436          | 343                     | 2                         | 6.6                                    | 12.1                                   | 8.6   | 83                         | 4                                     |
| Cumberland Co.   | 29,207          | 59,023          | 29,816                  | 102                       | 20.4                                   | 42.7                                   | 34.8  | 109                        | 95                                    |
| Davidson Co.     | 480,698         | 687,159         | 206,461                 | 43                        | 121.3                                  | 198.9                                  | 121.3   | 64                         | 72                                    |
| Decatur Co.      | 10,858          | 11,732          | 874                     | 8                         | 4.1                                    | 10.3                                   | 9.7   | 151                        | 8                                     |
| DeKalb Co.       | 13,574          | 19,876          | 6,302                   | 46                        | 8.8                                    | 16.7                                   | 12.3  | 90                         | 60                                    |
| Dickson Co.      | 30,328          | 52,774          | 22,446                  | 74                        | 14.5                                   | 31.4                                   | 26.4  | 117                        | 72                                    |
| Dyer Co.         | 34,386          | 37,339          | 2,953                   | 9                         | 12.0                                   | 17.6                                   | 8.8   | 47                         | 22                                    |

| Tennessee County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Fayette Co.      | 24,829          | 40,150          | 15,321                  | 62                        | 11.9                                   | 25.7                                   | 21.6  | 116                        | 62                                    |
| Fentress Co.     | 14,999          | 18,214          | 3,215                   | 21                        | 7.5                                    | 15.5                                   | 12.5  | 107                        | 27                                    |
| Franklin Co.     | 32,592          | 41,623          | 9,031                   | 28                        | 11.8                                   | 31.0                                   | 30.0  | 163                        | 25                                    |
| Gibson Co.       | 48,808          | 49,255          | 447                     | 1                         | 18.2                                   | 31.3                                   | 20.5  | 72                         | 2                                     |
| Giles Co.        | 24,867          | 29,379          | 4,512                   | 18                        | 8.5                                    | 17.3                                   | 13.8  | 104                        | 23                                    |
| Grainger Co.     | 17,014          | 23,106          | 6,092                   | 36                        | 5.4                                    | 14.8                                   | 14.7  | 174                        | 30                                    |
| Greene Co.       | 54,738          | 68,821          | 14,083                  | 26                        | 22.3                                   | 40.6                                   | 28.6  | 82                         | 38                                    |
| Grundy Co.       | 14,004          | 13,332          | -672                    | -5                        | 6.1                                    | 7.5                                    | 2.2   | 23                         | 0                                     |
| Hamblen Co.      | 51,193          | 64,062          | 12,869                  | 25                        | 17.1                                   | 31.8                                   | 23.0  | 86                         | 36                                    |
| Hamilton Co.     | 286,595         | 361,032         | 74,437                  | 26                        | 77.4                                   | 125.1                                  | 74.5  | 62                         | 48                                    |
| Hancock Co.      | 6,781           | 6,593           | -188                    | -3                        | 2.2                                    | 4.1                                    | 3.0   | 86                         | 0                                     |
| Hardeman Co.     | 23,388          | 25,488          | 2,100                   | 9                         | 16.4                                   | 21.9                                   | 8.6   | 34                         | 30                                    |

| Tennessee County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Hardin Co.       | 22,598          | 25,738          | 3,140                   | 14                        | 20.4                                   | 31.9                                   | 18.0  | 56                         | 29                                    |
| Hawkins Co.      | 44,349          | 56,620          | 12,271                  | 28                        | 17.2                                   | 36.5                                   | 30.2  | 112                        | 32                                    |
| Haywood Co.      | 20,100          | 17,607          | -2,493                  | -12                       | 8.2                                    | 11.1                                   | 4.5   | 35                         | 0                                     |
| Henderson Co.    | 21,489          | 27,851          | 6,362                   | 30                        | 8.7                                    | 16.2                                   | 11.7  | 86                         | 42                                    |
| Henry Co.        | 28,907          | 32,380          | 3,473                   | 12                        | 10.2                                   | 23.7                                   | 21.1  | 132                        | 13                                    |
| Hickman Co.      | 15,240          | 24,839          | 9,599                   | 63                        | 6.7                                    | 15.0                                   | 13.0  | 124                        | 61                                    |
| Houston Co.      | 7,056           | 8,158           | 1,102                   | 16                        | 3.0                                    | 6.8                                    | 5.9   | 127                        | 18                                    |
| Humphreys Co.    | 16,247          | 18,503          | 2,256                   | 14                        | 11.4                                   | 17.2                                   | 9.1   | 51                         | 32                                    |
| Jackson Co.      | 9,138           | 11,702          | 2,564                   | 28                        | 4.9                                    | 7.4                                    | 3.9   | 51                         | 60                                    |
| Jefferson Co.    | 32,294          | 53,730          | 21,436                  | 66                        | 14.5                                   | 33.4                                   | 29.5  | 130                        | 61                                    |
| Johnson Co.      | 14,013          | 17,603          | 3,590                   | 26                        | 5.5                                    | 13.3                                   | 12.2  | 142                        | 26                                    |
| Knox Co.         | 328,680         | 461,565         | 132,885                 | 40                        | 105.0                                  | 157.9                                  | 82.7  | 50                         | 83                                    |

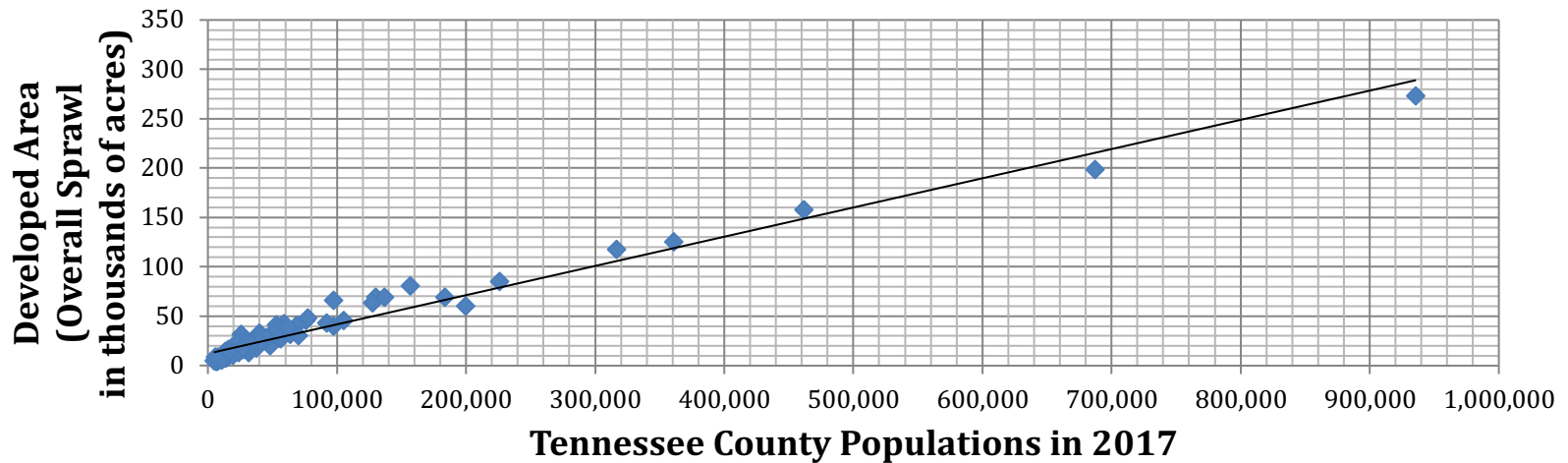
| Tennessee County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Lake Co.         | 8,229           | 7,451           | -778                    | -9                        | 3.0                                    | 4.5                                    | 2.3   | 50                         | 0                                     |
| Lauderdale Co.   | 24,109          | 26,093          | 1,984                   | 8                         | 8.8                                    | 16.0                                   | 11.3  | 82                         | 13                                    |
| Lawrence Co.     | 34,314          | 43,388          | 9,074                   | 26                        | 14.2                                   | 25.3                                   | 17.3  | 78                         | 41                                    |
| Lewis Co.        | 9,920           | 12,025          | 2,105                   | 21                        | 6.2                                    | 9.9                                    | 5.8   | 60                         | 41                                    |
| Lincoln Co.      | 26,417          | 33,892          | 7,475                   | 28                        | 5.6                                    | 22.6                                   | 26.6  | 304                        | 18                                    |
| Loudon Co.       | 30,166          | 52,260          | 22,094                  | 73                        | 14.1                                   | 35.3                                   | 33.1  | 150                        | 60                                    |
| McMinn Co.       | 42,495          | 52,931          | 10,436                  | 25                        | 23.0                                   | 41.3                                   | 28.6  | 80                         | 38                                    |
| McNairy Co.      | 22,710          | 26,001          | 3,291                   | 14                        | 11.6                                   | 24.9                                   | 20.8  | 115                        | 18                                    |
| Macon Co.        | 15,987          | 23,905          | 7,918                   | 50                        | 6.4                                    | 13.3                                   | 10.8  | 108                        | 55                                    |
| Madison Co.      | 76,019          | 97,491          | 21,472                  | 28                        | 27.3                                   | 40.2                                   | 20.2  | 47                         | 64                                    |
| Marion Co.       | 24,603          | 28,406          | 3,803                   | 15                        | 16.4                                   | 24.8                                   | 13.1  | 51                         | 35                                    |
| Marshall Co.     | 19,692          | 33,020          | 13,328                  | 68                        | 8.3                                    | 17.1                                   | 13.8  | 106                        | 72                                    |

| Tennessee County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Maury Co.        | 51,240          | 92,237          | 40,997                  | 80                        | 19.5                                   | 43.0                                   | 36.7  | 121                        | 74                                    |
| Meigs Co.        | 7,467           | 12,042          | 4,575                   | 61                        | 3.6                                    | 8.6                                    | 7.8   | 139                        | 55                                    |
| Monroe Co.       | 29,171          | 46,035          | 16,864                  | 58                        | 14.7                                   | 28.6                                   | 21.7  | 95                         | 69                                    |
| Montgomery Co.   | 88,267          | 199,771         | 111,504                 | 126                       | 22.7                                   | 60.6                                   | 59.2  | 167                        | 83                                    |
| Moore Co.        | 4,531           | 6,391           | 1,860                   | 41                        | 1.9                                    | 6.6                                    | 7.3   | 247                        | 28                                    |
| Morgan Co.       | 17,233          | 21,555          | 4,322                   | 25                        | 8.3                                    | 14.7                                   | 10.0  | 77                         | 39                                    |
| Obion Co.        | 32,825          | 30,375          | -2,450                  | -7                        | 12.9                                   | 22.6                                   | 15.2  | 75                         | 0                                     |
| Overton Co.      | 17,382          | 21,998          | 4,616                   | 27                        | 9.1                                    | 17.1                                   | 12.5  | 88                         | 37                                    |
| Perry Co.        | 6,264           | 7,954           | 1,690                   | 27                        | 2.8                                    | 5.3                                    | 3.9   | 89                         | 37                                    |
| Pickett Co.      | 4,490           | 5,062           | 572                     | 13                        | 2.9                                    | 4.9                                    | 3.1   | 69                         | 23                                    |
| Polk Co.         | 13,636          | 16,759          | 3,123                   | 23                        | 6.3                                    | 14.9                                   | 13.4  | 137                        | 24                                    |
| Putnam Co.       | 48,881          | 77,299          | 28,418                  | 58                        | 25.6                                   | 48.0                                   | 35.0  | 88                         | 73                                    |

| Tennessee County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Rhea Co.         | 24,334          | 32,671          | 8,337                   | 34                        | 9.8                                    | 20.6                                   | 16.9  | 110                        | 40                                    |
| Roane Co.        | 48,760          | 53,020          | 4,260                   | 9                         | 24.0                                   | 35.7                                   | 18.3  | 49                         | 21                                    |
| Robertson Co.    | 37,368          | 70,328          | 32,960                  | 88                        | 9.3                                    | 30.3                                   | 32.8  | 226                        | 54                                    |
| Rutherford Co.   | 90,073          | 316,531         | 226,458                 | 251                       | 34.8                                   | 117.9                                  | 129.8   | 239                        | 100                                   |
| Scott Co.        | 19,376          | 21,964          | 2,588                   | 13                        | 8.1                                    | 23.0                                   | 23.3  | 184                        | 12                                    |
| Sequatchie Co.   | 8,682           | 14,767          | 6,085                   | 70                        | 9.3                                    | 15.3                                   | 9.4   | 65                         | 100                                   |
| Sevier Co.       | 43,819          | 97,307          | 53,488                  | 122                       | 21.6                                   | 66.1                                   | 69.5  | 206                        | 71                                    |
| Shelby Co.       | 775,503         | 935,251         | 159,748                 | 21                        | 166.6                                  | 273.3                                  | 166.7   | 64                         | 38                                    |
| Smith Co.        | 14,535          | 19,732          | 5,197                   | 36                        | 7.6                                    | 13.8                                   | 9.7   | 82                         | 51                                    |
| Stewart Co.      | 8,743           | 13,422          | 4,679                   | 54                        | 6.7                                    | 14.1                                   | 11.6  | 110                        | 58                                    |
| Sullivan Co.     | 145,798         | 156,924         | 11,126                  | 8                         | 48.9                                   | 81.0                                   | 50.2  | 66                         | 15                                    |
| Sumner Co.       | 88,674          | 183,756         | 95,082                  | 107                       | 29.9                                   | 69.1                                   | 61.3  | 131                        | 87                                    |

| Tennessee County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Tipton Co.       | 33,419          | 61,305          | 27,886                  | 83                        | 18.7                                   | 39.6                                   | 32.7  | 112                        | 81                                    |
| Trousdale Co.    | 5,887           | 10,831          | 4,944                   | 84                        | 3.9                                    | 5.7                                    | 2.8   | 46                         | 100                                   |
| Unicoi Co.       | 16,595          | 17,796          | 1,201                   | 7                         | 5.7                                    | 11.4                                   | 8.9   | 100                        | 10                                    |
| Union Co.        | 12,138          | 19,399          | 7,261                   | 60                        | 4.0                                    | 10.6                                   | 10.3  | 165                        | 48                                    |
| Van Buren Co.    | 4,796           | 5,747           | 951                     | 20                        | 6.0                                    | 8.5                                    | 3.9   | 42                         | 52                                    |
| Warren Co.       | 32,977          | 40,717          | 7,740                   | 23                        | 14.8                                   | 24.1                                   | 14.5  | 63                         | 43                                    |
| Washington Co.   | 90,392          | 127,603         | 37,211                  | 41                        | 34.3                                   | 63.4                                   | 45.5  | 85                         | 56                                    |
| Wayne Co.        | 14,130          | 16,641          | 2,511                   | 18                        | 8.0                                    | 14.6                                   | 10.3  | 83                         | 27                                    |
| Weakley Co.      | 32,844          | 33,325          | 481                     | 1                         | 12.7                                   | 22.0                                   | 14.5  | 73                         | 3                                     |
| White Co.        | 19,637          | 26,764          | 7,127                   | 36                        | 10.9                                   | 18.1                                   | 11.3  | 66                         | 61                                    |
| Williamson Co.   | 61,560          | 226,048         | 164,488                 | 267                       | 34.6                                   | 85.5                                   | 79.5  | 147                        | 100                                   |
| Wilson Co.       | 57,050          | 136,691         | 79,641                  | 140                       | 22.9                                   | 69.3                                   | 72.5  | 203                        | 79                                    |

| Tennessee County        | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Totals</b>           | <b>4,646,043</b> | <b>6,708,799</b> | <b>2,062,756</b>        | <b>44</b>                 | <b>1,644.8</b>                         | <b>3,151.3</b>                         | <b>2,353.9</b>                                    | <b>92</b>                  | <b>57</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>55</b>                             |



**Scatter Plot for Tennessee County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.98**

**Texas**

| <b>Texas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Anderson Co.        | 41,873                 | 58,175                 | 16,302                         | 39                               | 17.8  | 31.5  | 17.8   | 31.5                              | 58   |
| Andrews Co.         | 15,142                 | 17,603                 | 2,461                          | 16                               | 18.0  | 31.8  | 18.0   | 31.8                              | 26   |
| Angelina Co.        | 67,879                 | 87,572                 | 19,693                         | 29                               | 18.2  | 44.9  | 18.2   | 44.9                              | 28   |
| Aransas Co.         | 16,105                 | 25,392                 | 9,287                          | 58                               | 14.4  | 22.2  | 14.4   | 22.2                              | 100  |
| Archer Co.          | 7,651                  | 8,783                  | 1,132                          | 15                               | 11.5  | 13.6  | 11.5   | 13.6                              | 82   |
| Armstrong Co.       | 1,967                  | 1,867                  | -100                           | -5                               | 4.1   | 4.3   | 4.1  | 4.3                               | 0  |
| Atascosa Co.        | 26,475                 | 49,083                 | 22,608                         | 85                               | 13.5  | 47.4  | 13.5   | 47.4                              | 49   |
| Austin Co.          | 19,408                 | 29,722                 | 10,314                         | 53                               | 14.6  | 20.9  | 14.6   | 20.9                              | 100  |
| Bailey Co.          | 8,138                  | 7,066                  | -1,072                         | -13                              | 4.9   | 5.3   | 4.9  | 5.3                               | 0  |
| Bandera Co.         | 7,559                  | 22,327                 | 14,768                         | 195                              | 10.8  | 25.3  | 10.8   | 25.3                              | 100  |
| Bastrop Co.         | 28,439                 | 84,585                 | 56,146                         | 197                              | 27.8  | 55.5  | 27.8   | 55.5                              | 100  |

| Texas County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Baylor Co.   | 5,229           | 3,555           | -1,674                  | -32                       | 8.9                                    | 9.9                                    | 8.9   | 9.9                        | 0                                     |
| Bee Co.      | 27,262          | 32,592          | 5,330                   | 20                        | 16.3                                   | 21.1                                   | 16.3  | 21.1                       | 69                                    |
| Bell Co.     | 167,053         | 347,377         | 180,324                 | 108                       | 52.7                                   | 121.4                                  | 52.7  | 121.4                      | 88                                    |
| Bexar Co.    | 1,046,457       | 1,956,988       | 910,531                 | 87                        | 163.5                                  | 304.6                                  | 163.5   | 304.6                      | 100                                   |
| Blanco Co.   | 4,791           | 11,481          | 6,690                   | 140                       | 5.0                                    | 8.3                                    | 5.0   | 8.3                        | 100                                   |
| Borden Co.   | 975             | 670             | -305                    | -31                       | 3.9                                    | 5.2                                    | 3.9   | 5.2                        | 0                                     |
| Bosque Co.   | 13,779          | 18,295          | 4,516                   | 33                        | 14.5                                   | 21.6                                   | 14.5  | 21.6                       | 71                                    |
| Bowie Co.    | 76,898          | 93,458          | 16,560                  | 22                        | 47.5                                   | 64.1                                   | 47.5  | 64.1                       | 65                                    |
| Brazoria Co. | 179,584         | 361,853         | 182,269                 | 101                       | 85.8                                   | 162.8                                  | 85.8  | 162.8                      | 100                                   |
| Brazos Co.   | 112,349         | 223,917         | 111,568                 | 99                        | 33.6                                   | 79.7                                   | 33.6  | 79.7                       | 80                                    |
| Brewster Co. | 7,878           | 9,325           | 1,447                   | 18                        | 15.5                                   | 15.7                                   | 15.5  | 15.7                       | 18                                    |
| Briscoe Co.  | 2,471           | 1,514           | -957                    | -39                       | 4.0                                    | 4.6                                    | 4.0   | 4.6                        | 0                                     |

| <b>Texas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Brooks Co.          | 8,630                  | 7,132                  | -1,498                         | -17                              | 6.4   | 10.6  | 6.4  | 10.6                              | 0  |
| Brown Co.           | 34,849                 | 37,815                 | 2,966                          | 9                                | 17.8  | 21.5  | 17.8   | 21.5                              | 43   |
| Burleson Co.        | 14,670                 | 18,053                 | 3,383                          | 23                               | 13.6  | 20.7  | 13.6   | 20.7                              | 49   |
| Burnet Co.          | 19,116                 | 46,600                 | 27,484                         | 144                              | 16.0  | 32.1  | 16.0   | 32.1                              | 100  |
| Caldwell Co.        | 24,538                 | 42,328                 | 17,790                         | 72                               | 12.9  | 23.9  | 12.9   | 23.9                              | 88   |
| Calhoun Co.         | 21,181                 | 21,712                 | 531                            | 3                                | 13.3  | 23.9  | 13.3   | 23.9                              | 4  |
| Callahan Co.        | 11,796                 | 13,968                 | 2,172                          | 18                               | 7.8   | 10.6  | 7.8  | 10.6                              | 55   |
| Cameron Co.         | 230,718                | 422,227                | 191,509                        | 83                               | 47.9  | 86.1  | 47.9   | 86.1                              | 100  |
| Camp Co.            | 9,797                  | 12,845                 | 3,048                          | 31                               | 4.6   | 7.8   | 4.6  | 7.8                               | 51   |
| Carson Co.          | 7,325                  | 6,005                  | -1,320                         | -18                              | 12.9  | 16.0  | 12.9   | 16.0                              | 0  |
| Cass Co.            | 30,710                 | 29,966                 | -744                           | -2                               | 15.5  | 26.8  | 15.5   | 26.8                              | 0  |
| Castro Co.          | 10,474                 | 7,696                  | -2,778                         | -27                              | 9.1   | 10.7  | 9.1  | 10.7                              | 0  |

| <b>Texas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Chambers Co.        | 19,676                 | 41,269                 | 21,593                         | 110                              | 24.3  | 39.9  | 24.3   | 39.9                              | 100  |
| Cherokee Co.        | 38,856                 | 52,116                 | 13,260                         | 34                               | 13.7  | 31.4  | 13.7   | 31.4                              | 35   |
| Childress Co.       | 6,937                  | 7,269                  | 332                            | 5                                | 4.7   | 6.3   | 4.7  | 6.3                               | 16   |
| Clay Co.            | 10,016                 | 10,484                 | 468                            | 5                                | 15.4  | 18.6  | 15.4   | 18.6                              | 24   |
| Cochran Co.         | 4,890                  | 2,853                  | -2,037                         | -42                              | 5.8   | 6.1   | 5.8  | 6.1                               | 0  |
| Coke Co.            | 3,546                  | 3,285                  | -261                           | -7                               | 8.4   | 10.4  | 8.4  | 10.4                              | 0  |
| Coleman Co.         | 10,578                 | 8,399                  | -2,179                         | -21                              | 15.3  | 18.0  | 15.3   | 18.0                              | 0  |
| Collin Co.          | 164,703                | 971,864                | 807,161                        | 490                              | 69.1  | 175.8   | 69.1   | 175.8                             | 100  |
| Collingsworth Co.   | 4,596                  | 2,964                  | -1,632                         | -36                              | 5.2   | 5.4   | 5.2  | 5.4                               | 0  |
| Colorado Co.        | 19,884                 | 21,291                 | 1,407                          | 7                                | 18.7  | 24.3  | 18.7   | 24.3                              | 26   |
| Comal Co.           | 39,057                 | 140,721                | 101,664                        | 260                              | 26.4  | 72.5  | 26.4   | 72.5                              | 100  |
| Comanche Co.        | 13,119                 | 13,533                 | 414                            | 3                                | 13.2  | 15.0  | 13.2   | 15.0                              | 24   |

| <b>Texas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Concho Co.          | 3,096                  | 2,707                  | -389                           | -13                              | 7.0   | 8.0   | 7.0  | 8.0                               | 0  |
| Cooke Co.           | 28,894                 | 39,932                 | 11,038                         | 38                               | 14.4  | 29.5  | 14.4   | 29.5                              | 45   |
| Coryell Co.         | 59,496                 | 74,760                 | 15,264                         | 26                               | 14.8  | 28.5  | 14.8   | 28.5                              | 35   |
| Cottle Co.          | 2,845                  | 1,375                  | -1,470                         | -52                              | 4.8   | 4.6   | 4.8  | 4.6                               | 0  |
| Crane Co.           | 5,115                  | 4,685                  | -430                           | -8                               | 5.1   | 7.1   | 5.1  | 7.1                               | 0  |
| Crockett Co.        | 5,155                  | 3,535                  | -1,620                         | -31                              | 24.2  | 29.1  | 24.2   | 29.1                              | 0  |
| Crosby Co.          | 8,560                  | 5,849                  | -2,711                         | -32                              | 6.5   | 8.1   | 6.5  | 8.1                               | 0  |
| Culberson Co.       | 3,574                  | 2,230                  | -1,344                         | -38                              | 5.9   | 6.0   | 5.9  | 6.0                               | 0  |
| Dallam Co.          | 6,587                  | 7,272                  | 685                            | 10                               | 3.1   | 3.5   | 3.1  | 3.5                               | 82   |
| Dallas Co.          | 1,637,637              | 2,620,154              | 982,517                        | 60                               | 263.3   | 373.0   | 263.3  | 373.0                             | 100  |
| Dawson Co.          | 16,645                 | 12,744                 | -3,901                         | -23                              | 11.5  | 14.8  | 11.5   | 14.8                              | 0  |
| Deaf Smith Co.      | 20,566                 | 18,753                 | -1,813                         | -9                               | 10.9  | 13.8  | 10.9   | 13.8                              | 0  |

| Texas County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Delta Co.    | 4,855           | 5,276           | 421                     | 9                         | 2.7                                    | 4.5                                    | 2.7   | 4.5                        | 16                                    |
| Denton Co.   | 166,463         | 835,364         | 668,901                 | 402                       | 45.6                                   | 154.2                                  | 45.6  | 154.2                      | 100                                   |
| DeWitt Co.   | 19,670          | 20,180          | 510                     | 3                         | 6.4                                    | 12.3                                   | 6.4   | 12.3                       | 4                                     |
| Dickens Co.  | 3,317           | 2,190           | -1,127                  | -34                       | 2.7                                    | 2.9                                    | 2.7   | 2.9                        | 0                                     |
| Dimmit Co.   | 11,948          | 10,282          | -1,666                  | -14                       | 5.9                                    | 15.1                                   | 5.9   | 15.1                       | 0                                     |
| Donley Co.   | 4,169           | 3,340           | -829                    | -20                       | 4.3                                    | 5.1                                    | 4.3   | 5.1                        | 0                                     |
| Duval Co.    | 13,083          | 11,270          | -1,813                  | -14                       | 15.7                                   | 23.2                                   | 15.7  | 23.2                       | 0                                     |
| Eastland Co. | 20,841          | 18,294          | -2,547                  | -12                       | 17.6                                   | 20.8                                   | 17.6  | 20.8                       | 0                                     |
| Ector Co.    | 135,501         | 156,951         | 21,450                  | 16                        | 54.4                                   | 72.9                                   | 54.4  | 72.9                       | 50                                    |
| Edwards Co.  | 2,218           | 1,929           | -289                    | -13                       | 7.8                                    | 10.2                                   | 7.8   | 10.2                       | 0                                     |
| Ellis Co.    | 62,621          | 173,405         | 110,784                 | 177                       | 20.6                                   | 92.3                                   | 20.6  | 92.3                       | 68                                    |
| El Paso Co.  | 511,892         | 837,401         | 325,509                 | 64                        | 76.9                                   | 153.7                                  | 76.9  | 153.7                      | 71                                    |

| Texas County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Erath Co.     | 23,921          | 41,723          | 17,802                  | 74                        | 20.2                                   | 31.6                                   | 20.2  | 31.6                       | 100                                   |
| Falls Co.     | 18,321          | 17,340          | -981                    | -5                        | 13.3                                   | 20.1                                   | 13.3  | 20.1                       | 0                                     |
| Fannin Co.    | 24,324          | 34,550          | 10,226                  | 42                        | 12.3                                   | 16.8                                   | 12.3  | 16.8                       | 100                                   |
| Fayette Co.   | 20,962          | 25,119          | 4,157                   | 20                        | 16.2                                   | 28.5                                   | 16.2  | 28.5                       | 32                                    |
| Fisher Co.    | 5,833           | 3,874           | -1,959                  | -34                       | 6.6                                    | 6.9                                    | 6.6   | 6.9                        | 0                                     |
| Floyd Co.     | 9,526           | 5,830           | -3,696                  | -39                       | 7.1                                    | 8.4                                    | 7.1   | 8.4                        | 0                                     |
| Foard Co.     | 2,125           | 1,202           | -923                    | -43                       | 4.4                                    | 4.0                                    | 4.4   | 4.0                        | 0                                     |
| Fort Bend Co. | 157,335         | 767,712         | 610,377                 | 388                       | 61.5                                   | 155.2                                  | 61.5  | 155.2                      | 100                                   |
| Franklin Co.  | 7,259           | 10,798          | 3,539                   | 49                        | 5.0                                    | 11.0                                   | 5.0   | 11.0                       | 50                                    |
| Freestone Co. | 15,825          | 19,649          | 3,824                   | 24                        | 8.2                                    | 18.4                                   | 8.2   | 18.4                       | 27                                    |
| Frio Co.      | 14,155          | 19,895          | 5,740                   | 41                        | 10.8                                   | 17.4                                   | 10.8  | 17.4                       | 71                                    |
| Gaines Co.    | 14,011          | 20,553          | 6,542                   | 47                        | 16.2                                   | 25.1                                   | 16.2  | 25.1                       | 88                                    |

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|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Galveston Co.       | 208,781                | 334,633                | 125,852                        | 60                               | 73.1  | 110.3   | 73.1   | 110.3                             | 100  |
| Garza Co.           | 5,802                  | 6,490                  | 688                            | 12                               | 3.6   | 3.5   | 3.6  | 3.5                               | 0  |
| Gillespie Co.       | 14,409                 | 26,483                 | 12,074                         | 84                               | 17.2  | 33.0  | 17.2   | 33.0                              | 93   |
| Glasscock Co.       | 1,298                  | 1,363                  | 65                             | 5                                | 4.9   | 11.6  | 4.9  | 11.6                              | 6  |
| Goliad Co.          | 5,541                  | 7,552                  | 2,011                          | 36                               | 6.5   | 9.9   | 6.5  | 9.9                               | 74   |
| Gonzales Co.        | 18,569                 | 20,742                 | 2,173                          | 12                               | 13.8  | 17.1  | 13.8   | 17.1                              | 52   |
| Gray Co.            | 28,243                 | 22,106                 | -6,137                         | -22                              | 16.8  | 19.3  | 16.8   | 19.3                              | 0  |
| Grayson Co.         | 91,857                 | 131,152                | 39,295                         | 43                               | 34.4  | 72.7  | 34.4   | 72.7                              | 48   |
| Gregg Co.           | 109,624                | 122,852                | 13,228                         | 12                               | 31.5  | 58.7  | 31.5   | 58.7                              | 18   |
| Grimes Co.          | 15,659                 | 27,955                 | 12,296                         | 79                               | 6.2   | 20.2  | 6.2  | 20.2                              | 49   |
| Guadalupe Co.       | 50,038                 | 159,639                | 109,601                        | 219                              | 21.7  | 46.5  | 21.7   | 46.5                              | 100  |
| Hale Co.            | 38,023                 | 33,954                 | -4,069                         | -11                              | 13.1  | 19.6  | 13.1   | 19.6                              | 0  |

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|---------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Hall Co.      | 5,226           | 3,042           | -2,184                  | -42                       | 5.0                                    | 4.8                                    | 5.0   | 4.8                        | 0                                     |
| Hamilton Co.  | 8,239           | 8,407           | 168                     | 2                         | 7.9                                    | 9.9                                    | 7.9   | 9.9                        | 9                                     |
| Hansford Co.  | 6,389           | 5,485           | -904                    | -14                       | 4.5                                    | 3.6                                    | 4.5   | 3.6                        | 68                                    |
| Hardeman Co.  | 6,472           | 3,959           | -2,513                  | -39                       | 10.2                                   | 11.0                                   | 10.2  | 11.0                       | 0                                     |
| Hardin Co.    | 42,235          | 57,117          | 14,882                  | 35                        | 40.5                                   | 54.4                                   | 40.5  | 54.4                       | 100                                   |
| Harris Co.    | 2,696,632       | 4,657,972       | 1,961,340               | 73                        | 402.9                                  | 675.6                                  | 402.9   | 675.6                      | 100                                   |
| Harrison Co.  | 55,528          | 66,468          | 10,940                  | 20                        | 14.4                                   | 41.3                                   | 14.4  | 41.3                       | 17                                    |
| Hartley Co.   | 3,992           | 5,716           | 1,724                   | 43                        | 5.1                                    | 5.9                                    | 5.1   | 5.9                        | 100                                   |
| Haskell Co.   | 7,657           | 5,699           | -1,958                  | -26                       | 11.4                                   | 13.3                                   | 11.4  | 13.3                       | 0                                     |
| Hays Co.      | 43,502          | 214,726         | 171,224                 | 394                       | 13.2                                   | 69.8                                   | 13.2  | 69.8                       | 96                                    |
| Hemphill Co.  | 6,427           | 3,929           | -2,498                  | -39                       | 3.4                                    | 10.7                                   | 3.4   | 10.7                       | 0                                     |
| Henderson Co. | 46,057          | 80,954          | 34,897                  | 76                        | 39.0                                   | 69.7                                   | 39.0  | 69.7                       | 97                                    |

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|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Hidalgo Co.    | 313,256         | 856,249         | 542,993                 | 173                       | 61.9                                   | 148.8                                  | 61.9  | 148.8                      | 100                                   |
| Hill Co.       | 25,748          | 35,703          | 9,955                   | 39                        | 16.3                                   | 34.9                                   | 16.3  | 34.9                       | 43                                    |
| Hockley Co.    | 24,679          | 22,977          | -1,702                  | -7                        | 8.4                                    | 15.0                                   | 8.4   | 15.0                       | 0                                     |
| Hood Co.       | 19,418          | 57,973          | 38,555                  | 199                       | 28.1                                   | 38.7                                   | 28.1  | 38.7                       | 100                                   |
| Hopkins Co.    | 26,366          | 36,451          | 10,085                  | 38                        | 10.7                                   | 16.3                                   | 10.7  | 16.3                       | 77                                    |
| Houston Co.    | 22,509          | 23,089          | 580                     | 3                         | 8.4                                    | 12.9                                   | 8.4   | 12.9                       | 6                                     |
| Howard Co.     | 36,541          | 35,817          | -724                    | -2                        | 12.4                                   | 27.5                                   | 12.4  | 27.5                       | 0                                     |
| Hudspeth Co.   | 3,057           | 4,604           | 1,547                   | 51                        | 12.1                                   | 12.5                                   | 12.1  | 12.5                       | 100                                   |
| Hunt Co.       | 58,758          | 94,046          | 35,288                  | 60                        | 32.0                                   | 57.8                                   | 32.0  | 57.8                       | 80                                    |
| Hutchinson Co. | 29,899          | 21,343          | -8,556                  | -29                       | 12.0                                   | 16.8                                   | 12.0  | 16.8                       | 0                                     |
| Irion Co.      | 1,549           | 1,512           | -37                     | -2                        | 5.9                                    | 9.0                                    | 5.9   | 9.0                        | 0                                     |
| Jack Co.       | 7,953           | 8,828           | 875                     | 11                        | 12.5                                   | 16.1                                   | 12.5  | 16.1                       | 41                                    |

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|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Jackson Co.    | 13,905          | 14,806          | 901                     | 6                         | 12.0                                   | 15.6                                   | 12.0  | 15.6                       | 24                                    |
| Jasper Co.     | 31,449          | 35,549          | 4,100                   | 13                        | 18.6                                   | 43.4                                   | 18.6  | 43.4                       | 14                                    |
| Jeff Davis Co. | 1,650           | 2,260           | 610                     | 37                        | 3.9                                    | 7.6                                    | 3.9   | 7.6                        | 47                                    |
| Jefferson Co.  | 256,258         | 256,041         | -217                    | 0                         | 73.6                                   | 122.4                                  | 73.6  | 122.4                      | 0                                     |
| Jim Hogg Co.   | 5,467           | 5,212           | -255                    | -5                        | 9.5                                    | 5.1                                    | 9.5   | 5.1                        | 8                                     |
| Jim Wells Co.  | 38,677          | 40,920          | 2,243                   | 6                         | 13.8                                   | 21.5                                   | 13.8  | 21.5                       | 13                                    |
| Johnson Co.    | 73,412          | 167,012         | 93,600                  | 127                       | 25.2                                   | 84.8                                   | 25.2  | 84.8                       | 68                                    |
| Jones Co.      | 17,693          | 19,827          | 2,134                   | 12                        | 12.2                                   | 20.7                                   | 12.2  | 20.7                       | 22                                    |
| Karnes Co.     | 13,777          | 15,556          | 1,779                   | 13                        | 9.6                                    | 19.9                                   | 9.6   | 19.9                       | 17                                    |
| Kaufman Co.    | 41,570          | 122,628         | 81,058                  | 195                       | 19.8                                   | 40.6                                   | 19.8  | 40.6                       | 100                                   |
| Kendall Co.    | 11,390          | 43,969          | 32,579                  | 286                       | 25.2                                   | 37.0                                   | 25.2  | 37.0                       | 100                                   |
| Kenedy Co.     | 514             | 427             | -87                     | -17                       | 5.0                                    | 7.0                                    | 5.0   | 7.0                        | 0                                     |

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|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Kent Co.            | 1,177                  | 759                    | -418                           | -36                              | 3.2   | 5.3   | 3.2  | 5.3                               | 0  |
| Kerr Co.            | 30,292                 | 51,892                 | 21,600                         | 71                               | 36.5  | 51.1  | 36.5   | 51.1                              | 100  |
| Kimble Co.          | 4,171                  | 4,385                  | 214                            | 5                                | 4.3   | 5.7   | 4.3  | 5.7                               | 18   |
| King Co.            | 420                    | 289                    | -131                           | -31                              | 2.3   | 2.4   | 2.3  | 2.4                               | 0  |
| Kinney Co.          | 2,408                  | 3,711                  | 1,303                          | 54                               | 5.7   | 5.7   | 5.7  | 5.7                               | 0  |
| Kleberg Co.         | 34,743                 | 30,752                 | -3,991                         | -11                              | 11.8  | 21.2  | 11.8   | 21.2                              | 0  |
| Knox Co.            | 5,617                  | 3,674                  | -1,943                         | -35                              | 11.1  | 12.4  | 11.1   | 12.4                              | 0  |
| Lamar Co.           | 42,676                 | 49,568                 | 6,892                          | 16                               | 31.9  | 51.4  | 31.9   | 51.4                              | 31   |
| Lamb Co.            | 18,661                 | 13,165                 | -5,496                         | -29                              | 10.7  | 13.0  | 10.7   | 13.0                              | 0  |
| Lampasas Co.        | 12,499                 | 20,861                 | 8,362                          | 67                               | 16.4  | 21.5  | 16.4   | 21.5                              | 100  |
| La Salle Co.        | 5,926                  | 7,530                  | 1,604                          | 27                               | 6.6   | 11.1  | 6.6  | 11.1                              | 46   |
| Lavaca Co.          | 19,578                 | 20,028                 | 450                            | 2                                | 18.0  | 22.6  | 18.0   | 22.6                              | 10   |

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|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Lee Co.             | 14,048                 | 17,109                 | 3,061                          | 22                               | 9.5   | 13.3  | 9.5  | 13.3                              | 59   |
| Leon Co.            | 10,719                 | 17,235                 | 6,516                          | 61                               | 12.9  | 23.5  | 12.9   | 23.5                              | 79   |
| Liberty Co.         | 51,576                 | 83,597                 | 32,021                         | 62                               | 31.9  | 69.5  | 31.9   | 69.5                              | 62   |
| Limestone Co.       | 20,688                 | 23,391                 | 2,703                          | 13                               | 13.2  | 21.4  | 13.2   | 21.4                              | 25   |
| Lipscomb Co.        | 4,465                  | 3,364                  | -1,101                         | -25                              | 7.4   | 13.2  | 7.4  | 13.2                              | 0.0  |
| Live Oak Co.        | 9,932                  | 12,146                 | 2,214                          | 22                               | 14.1  | 22.2  | 14.1   | 22.2                              | 44   |
| Llano Co.           | 10,567                 | 21,167                 | 10,600                         | 100                              | 12.8  | 24.2  | 12.8   | 24.2                              | 100  |
| Loving Co.          | 84                     | 133                    | 49                             | 58                               | 2.8   | 6.6   | 2.8  | 6.6                               | 54   |
| Lubbock Co.         | 215,688                | 305,413                | 89,725                         | 42                               | 43.0  | 81.1  | 43.0   | 81.1                              | 55   |
| Lynn Co.            | 8,245                  | 5,832                  | -2,413                         | -29                              | 8.8   | 10.0  | 8.8  | 10.0                              | 0  |
| McCulloch Co.       | 8,890                  | 7,941                  | -949                           | -11                              | 11.2  | 17.3  | 11.2   | 17.3                              | 0  |
| McLennan Co.        | 175,640                | 251,631                | 75,991                         | 43                               | 47.5  | 66.6  | 47.5   | 66.6                              | 100  |

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| McMullen Co.  | 828             | 765             | -63                     | -8                        | 3.9                                    | 8.2                                    | 3.9   | 8.2                        | 0                                     |
| Madison Co.   | 11,547          | 14,251          | 2,704                   | 23                        | 7.1                                    | 11.8                                   | 7.1   | 11.8                       | 41                                    |
| Marion Co.    | 10,825          | 10,057          | -768                    | -7                        | 6.2                                    | 9.3                                    | 6.2   | 9.3                        | 0                                     |
| Martin Co.    | 5,306           | 5,531           | 225                     | 4                         | 8.1                                    | 25.2                                   | 8.1   | 25.2                       | 4                                     |
| Mason Co.     | 3,657           | 4,179           | 522                     | 14                        | 4.8                                    | 6.5                                    | 4.8   | 6.5                        | 44                                    |
| Matagorda Co. | 37,325          | 36,805          | -520                    | -1                        | 22.5                                   | 29.1                                   | 22.5  | 29.1                       | 0                                     |
| Maverick Co.  | 34,029          | 58,111          | 24,082                  | 71                        | 13.1                                   | 26.1                                   | 13.1  | 26.1                       | 78                                    |
| Medina Co.    | 23,569          | 50,183          | 26,614                  | 113                       | 23.8                                   | 33.3                                   | 23.8  | 33.3                       | 100                                   |
| Menard Co.    | 2,313           | 2,110           | -203                    | -9                        | 1.9                                    | 2.2                                    | 1.9   | 2.2                        | 0                                     |
| Midland Co.   | 98,653          | 165,318         | 66,665                  | 68                        | 41.0                                   | 85.8                                   | 41.0  | 85.8                       | 70                                    |
| Milam Co.     | 23,255          | 24,939          | 1,684                   | 7                         | 15.2                                   | 23.7                                   | 15.2  | 23.7                       | 16                                    |
| Mills Co.     | 4,554           | 4,917           | 363                     | 8                         | 6.2                                    | 7.2                                    | 6.2   | 7.2                        | 51                                    |

| <b>Texas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Mitchell Co.        | 9,605                  | 8,215                  | -1,390                         | -14                              | 6.8   | 9.2   | 6.8  | 9.2                               | 0  |
| Montague Co.        | 18,529                 | 19,399                 | 870                            | 5                                | 15.0  | 21.7  | 15.0   | 21.7                              | 12   |
| Montgomery Co.      | 150,025                | 571,615                | 421,590                        | 281                              | 89.9  | 229.9   | 89.9   | 229.9                             | 100  |
| Moore Co.           | 17,756                 | 21,604                 | 3,848                          | 22                               | 11.6  | 18.4  | 11.6   | 18.4                              | 43   |
| Morris Co.          | 15,464                 | 12,375                 | -3,089                         | -20                              | 5.9   | 14.2  | 5.9  | 14.2                              | 0  |
| Motley Co.          | 1,871                  | 1,226                  | -645                           | -34                              | 2.1   | 2.2   | 2.1  | 2.2                               | 0  |
| Nacogdoches Co.     | 48,978                 | 65,317                 | 16,339                         | 33                               | 22.0  | 35.2  | 22.0   | 35.2                              | 61   |
| Navarro Co.         | 37,097                 | 48,739                 | 11,642                         | 31                               | 13.3  | 27.6  | 13.3   | 27.6                              | 37   |
| Newton Co.          | 13,405                 | 13,908                 | 503                            | 4                                | 4.6   | 10.3  | 4.6  | 10.3                              | 5  |
| Nolan Co.           | 18,163                 | 14,854                 | -3,309                         | -18                              | 11.1  | 15.8  | 11.1   | 15.8                              | 0  |
| Nueces Co.          | 282,413                | 361,235                | 78,822                         | 28                               | 51.2  | 90.5  | 51.2   | 90.5                              | 43   |
| Ochiltree Co.       | 11,057                 | 9,996                  | -1,061                         | -10                              | 8.1   | 10.6  | 8.1  | 10.6                              | 0  |

| Texas County   | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Oldham Co.     | 2,350           | 2,104           | -246                    | -10                       | 5.2                                    | 6.1                                    | 5.2   | 6.1                        | 0                                     |
| Orange Co.     | 87,402          | 84,971          | -2,431                  | -3                        | 35.4                                   | 72.0                                   | 35.4  | 72.0                       | 0                                     |
| Palo Pinto Co. | 25,605          | 28,544          | 2,939                   | 11                        | 26.2                                   | 35.4                                   | 26.2  | 35.4                       | 36                                    |
| Panola Co.     | 22,067          | 23,211          | 1,144                   | 5                         | 10.5                                   | 25.5                                   | 10.5  | 25.5                       | 6                                     |
| Parker Co.     | 47,243          | 133,501         | 86,258                  | 183                       | 38.3                                   | 76.1                                   | 38.3  | 76.1                       | 100                                   |
| Parmer Co.     | 10,943          | 9,710           | -1,233                  | -11                       | 10.0                                   | 11.1                                   | 10.0  | 11.1                       | 0                                     |
| Pecos Co.      | 16,946          | 15,634          | -1,312                  | -8                        | 46.6                                   | 125.6                                  | 46.6  | 125.6                      | 0                                     |
| Polk Co.       | 26,044          | 48,990          | 22,946                  | 88                        | 23.0                                   | 34.9                                   | 23.0  | 34.9                       | 100                                   |
| Potter Co.     | 102,612         | 120,340         | 17,728                  | 17                        | 36.5                                   | 60.2                                   | 36.5  | 60.2                       | 32                                    |
| Presidio Co.   | 5,475           | 7,100           | 1,625                   | 30                        | 6.6                                    | 6.8                                    | 6.6   | 6.8                        | 100                                   |
| Rains Co.      | 5,247           | 11,730          | 6,483                   | 124                       | 4.0                                    | 7.7                                    | 4.0   | 7.7                        | 100                                   |
| Randall Co.    | 78,305          | 134,015         | 55,710                  | 71                        | 24.9                                   | 38.9                                   | 24.9  | 38.9                       | 100                                   |

| Texas County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Reagan Co.    | 4,899           | 3,712           | -1,187                  | -24                       | 7.8                                    | 11.3                                   | 7.8   | 11.3                       | 0                                     |
| Real Co.      | 2,524           | 3,417           | 893                     | 35                        | 5.3                                    | 7.6                                    | 5.3   | 7.6                        | 84                                    |
| Red River Co. | 15,803          | 12,164          | -3,639                  | -23                       | 14.4                                   | 20.4                                   | 14.4  | 20.4                       | 0                                     |
| Reeves Co.    | 17,257          | 15,166          | -2,091                  | -12                       | 13.8                                   | 27.0                                   | 13.8  | 27.0                       | 0                                     |
| Refugio Co.   | 9,379           | 7,180           | -2,199                  | -23                       | 9.8                                    | 11.9                                   | 9.8   | 11.9                       | 0                                     |
| Roberts Co.   | 1,224           | 941             | -283                    | -23                       | 4.6                                    | 6.0                                    | 4.6   | 6.0                        | 0                                     |
| Robertson Co. | 15,452          | 17,153          | 1,701                   | 11                        | 15.5                                   | 23.7                                   | 15.5  | 23.7                       | 25                                    |
| Rockwall Co.  | 16,644          | 96,824          | 80,180                  | 482                       | 6.6                                    | 29.0                                   | 6.6   | 29.0                       | 100                                   |
| Runnels Co.   | 12,206          | 10,282          | -1,924                  | -16                       | 7.2                                    | 9.9                                    | 7.2   | 9.9                        | 0                                     |
| Rusk Co.      | 43,274          | 54,213          | 10,939                  | 25                        | 23.0                                   | 54.5                                   | 23.0  | 54.5                       | 26                                    |
| Sabine Co.    | 8,955           | 10,417          | 1,462                   | 16                        | 3.8                                    | 8.6                                    | 3.8   | 8.6                        | 19                                    |

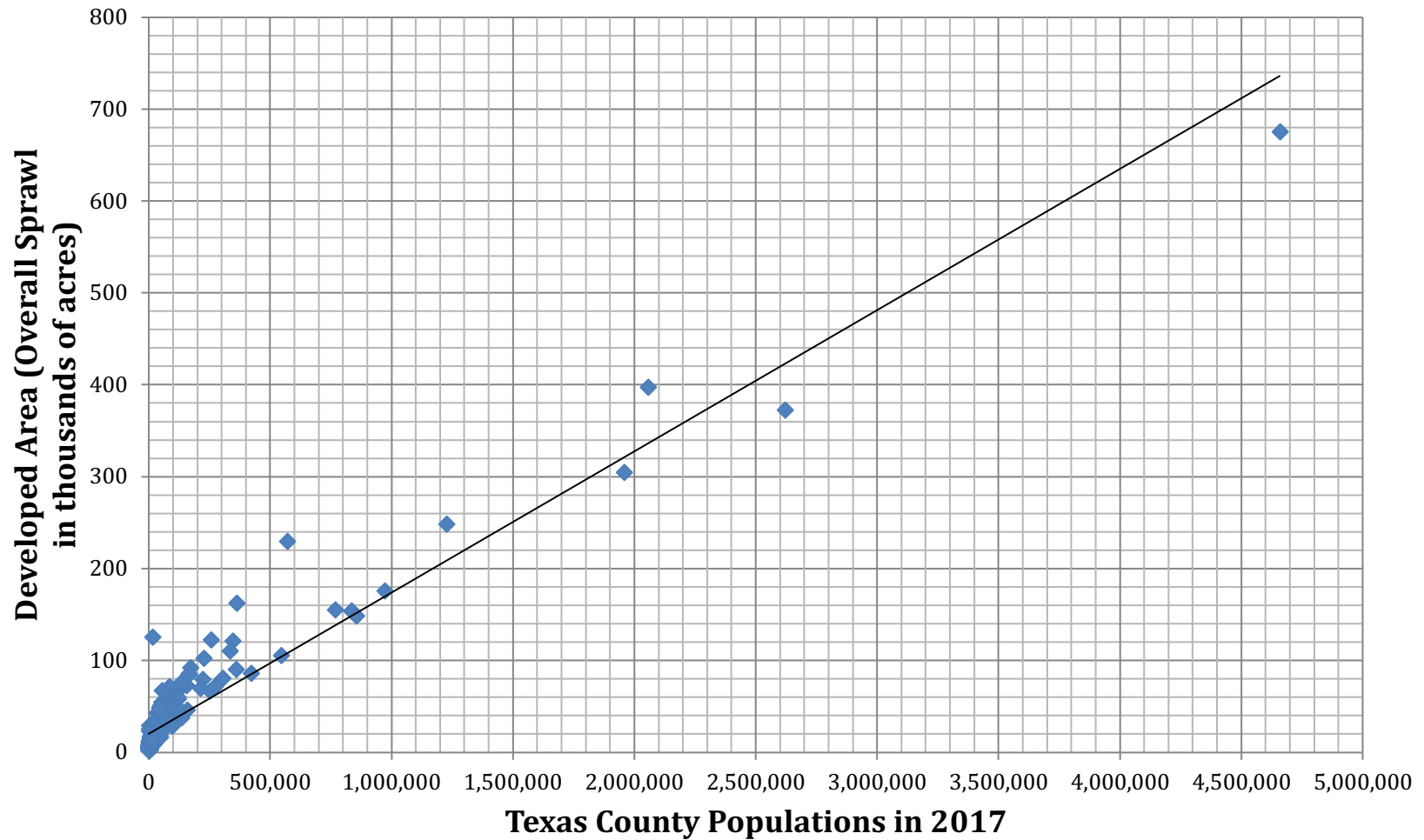
| Texas County      | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| San Augustine Co. | 8,929           | 8,302           | -627                    | -7                        | 4.7                                    | 17.9                                   | 4.7   | 17.9                       | 0                                     |
| San Jacinto Co.   | 12,297          | 28,231          | 15,934                  | 130                       | 14.4                                   | 28.5                                   | 14.4  | 28.5                       | 100                                   |
| San Patricio Co.  | 61,470          | 67,210          | 5,740                   | 9                         | 31.2                                   | 52.8                                   | 31.2  | 52.8                       | 17                                    |
| San Saba Co.      | 5,847           | 5,996           | 149                     | 3                         | 6.8                                    | 7.5                                    | 6.8   | 7.5                        | 26                                    |
| Schleicher Co.    | 3,219           | 2,989           | -230                    | -7                        | 5.4                                    | 11.3                                   | 5.4   | 11.3                       | 0                                     |
| Scurry Co.        | 20,018          | 17,003          | -3,015                  | -15                       | 13.3                                   | 23.7                                   | 13.3  | 23.7                       | 0                                     |
| Shackelford Co.   | 4,235           | 3,289           | -946                    | -22                       | 5.4                                    | 5.8                                    | 5.4   | 5.8                        | 0                                     |
| Shelby Co.        | 23,263          | 25,225          | 1,962                   | 8                         | 6.2                                    | 19.4                                   | 6.2   | 19.4                       | 7                                     |
| Sherman Co.       | 3,234           | 3,046           | -188                    | -6                        | 4.8                                    | 5.9                                    | 4.8   | 5.9                        | 0                                     |
| Smith Co.         | 137,348         | 227,195         | 89,847                  | 65                        | 40.3                                   | 102.7                                  | 40.3  | 102.7                      | 54                                    |
| Somervell Co.     | 4,373           | 8,855           | 4,482                   | 102                       | 5.0                                    | 8.7                                    | 5.0   | 8.7                        | 100                                   |

| Texas County     | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Starr Co.        | 30,442          | 64,130          | 33,688                  | 111                       | 19.0                                   | 34.2                                   | 19.0  | 34.2                       | 100                                   |
| Stephens Co.     | 10,895          | 9,287           | -1,608                  | -15                       | 9.8                                    | 11.2                                   | 9.8   | 11.2                       | 0                                     |
| Sterling Co.     | 1,401           | 1,287           | -114                    | -8                        | 7.0                                    | 8.5                                    | 7.0   | 8.5                        | 0                                     |
| Stonewall Co.    | 2,424           | 1,376           | -1,048                  | -43                       | 4.3                                    | 4.8                                    | 4.3   | 4.8                        | 0                                     |
| Sutton Co.       | 5,878           | 3,792           | -2,086                  | -35                       | 13.2                                   | 25.6                                   | 13.2  | 25.6                       | 0                                     |
| Swisher Co.      | 9,261           | 7,446           | -1,815                  | -20                       | 9.1                                    | 10.7                                   | 9.1   | 10.7                       | 0                                     |
| Tarrant Co.      | 933,829         | 2,056,451       | 1,122,622               | 120                       | 207.9                                  | 397.5                                  | 207.9   | 397.5                      | 100                                   |
| Taylor Co.       | 119,410         | 136,634         | 17,224                  | 14                        | 27.5                                   | 38.1                                   | 27.5  | 38.1                       | 41                                    |
| Terrell Co.      | 1,568           | 814             | -754                    | -48                       | 4.0                                    | 6.6                                    | 4.0   | 6.6                        | 0                                     |
| Terry Co.        | 15,015          | 12,429          | -2,586                  | -17                       | 13.7                                   | 16.3                                   | 13.7  | 16.3                       | 0                                     |
| Throckmorton Co. | 2,250           | 1,510           | -740                    | -33                       | 4.7                                    | 5.4                                    | 4.7   | 5.4                        | 0                                     |
| Titus Co.        | 22,606          | 32,619          | 10,013                  | 44                        | 7.6                                    | 16.1                                   | 7.6   | 16.1                       | 49                                    |

| <b>Texas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Tom Green Co.       | 90,883                 | 117,566                | 26,683                         | 29                               | 36.7  | 49.3  | 36.7   | 49.3                              | 87   |
| Travis Co.          | 449,814                | 1,227,585              | 777,771                        | 173                              | 134.5   | 248.6   | 134.5  | 248.6                             | 100  |
| Trinity Co.         | 10,214                 | 14,677                 | 4,463                          | 44                               | 9.2   | 19.5  | 9.2  | 19.5                              | 48   |
| Tyler Co.           | 16,531                 | 21,517                 | 4,986                          | 30                               | 18.5  | 31.5  | 18.5   | 31.5                              | 50   |
| Upshur Co.          | 31,213                 | 41,069                 | 9,856                          | 32                               | 11.0  | 26.9  | 11.0   | 26.9                              | 31   |
| Upton Co.           | 5,387                  | 3,658                  | -1,729                         | -32                              | 10.3  | 23.4  | 10.3   | 23.4                              | 0  |
| Uvalde Co.          | 23,096                 | 27,043                 | 3,947                          | 17                               | 13.8  | 16.0  | 13.8   | 16.0                              | 100  |
| Val Verde Co.       | 38,388                 | 49,028                 | 10,640                         | 28                               | 9.3   | 16.5  | 9.3  | 16.5                              | 43   |
| Van Zandt Co.       | 32,776                 | 55,163                 | 22,387                         | 68                               | 22.0  | 67.2  | 22.0   | 67.2                              | 47   |
| Victoria Co.        | 74,178                 | 92,045                 | 17,867                         | 24                               | 37.6  | 49.8  | 37.6   | 49.8                              | 77   |
| Walker Co.          | 46,011                 | 72,816                 | 26,805                         | 58                               | 19.3  | 38.7  | 19.3   | 38.7                              | 66   |
| Waller Co.          | 21,913                 | 51,717                 | 29,804                         | 136                              | 23.8  | 43.8  | 23.8   | 43.8                              | 100  |

| <b>Texas County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|---------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Ward Co.            | 16,211                 | 11,383                 | -4,828                         | -30                              | 12.0  | 17.2  | 12.0   | 17.2                              | 0  |
| Washington Co.      | 24,240                 | 34,861                 | 10,621                         | 44                               | 12.5  | 21.1  | 12.5   | 21.1                              | 69   |
| Webb Co.            | 111,106                | 273,691                | 162,585                        | 146                              | 25.9  | 71.6  | 25.9   | 71.6                              | 89   |
| Wharton Co.         | 41,247                 | 41,837                 | 590                            | 1                                | 20.1  | 27.1  | 20.1   | 27.1                              | 5  |
| Wheeler Co.         | 7,999                  | 5,300                  | -2,699                         | -34                              | 5.7   | 10.4  | 5.7  | 10.4                              | 0  |
| Wichita Co.         | 125,166                | 131,689                | 6,523                          | 5                                | 34.1  | 44.7  | 34.1   | 44.7                              | 19   |
| Wilbarger Co.       | 16,493                 | 12,683                 | -3,810                         | -23                              | 10.4  | 11.1  | 10.4   | 11.1                              | 0  |
| Willacy Co.         | 18,146                 | 21,508                 | 3,362                          | 19                               | 7.4   | 9.0   | 7.4  | 9.0                               | 87   |
| Williamson Co.      | 87,159                 | 546,251                | 459,092                        | 527                              | 44.8  | 105.4   | 44.8   | 105.4                             | 100  |
| Wilson Co.          | 17,591                 | 49,211                 | 31,620                         | 180                              | 10.8  | 20.1  | 10.8   | 20.1                              | 100  |
| Winkler Co.         | 11,654                 | 7,605                  | -4,049                         | -35                              | 4.9   | 8.2   | 4.9  | 8.2                               | 0  |
| Wise Co.            | 28,373                 | 65,848                 | 37,475                         | 132                              | 16.0  | 34.1  | 16.0   | 34.1                              | 100  |

| Texas County            | 1982 Population   | 2017 Population   | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-------------------|-------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Wood Co.                | 25,610            | 44,263            | 18,653                  | 73                        | 15.3                                   | 49.0                                   | 15.3  | 49.0                       | 47                                    |
| Yoakum Co.              | 8,510             | 8,557             | 47                      | 1                         | 9.2                                    | 12.9                                   | 9.2   | 12.9                       | 2                                     |
| Young Co.               | 20,546            | 17,922            | -2,624                  | -13                       | 15.3                                   | 17.9                                   | 15.3  | 17.9                       | 0                                     |
| Zapata Co.              | 7,690             | 14,254            | 6,564                   | 85                        | 6.8                                    | 15.9                                   | 6.8   | 15.9                       | 73                                    |
| Zavala Co.              | 12,197            | 11,957            | -240                    | -2                        | 6.2                                    | 10.8                                   | 6.2   | 10.8                       | 0                                     |
| <b>Totals</b>           | <b>15,331,408</b> | <b>28,295,273</b> | <b>12,963,865</b>       | <b>85</b>                 | <b>5,284.8</b>                         | <b>9,530.4</b>                         | <b>5,284.8</b>                                    | <b>9,530.4</b>             | <b>100</b>                            |
| <b>Weighted Average</b> |                   |                   |                         |                           |  |  |   |                            | <b>70</b>                             |



**Scatter Plot for Texas County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

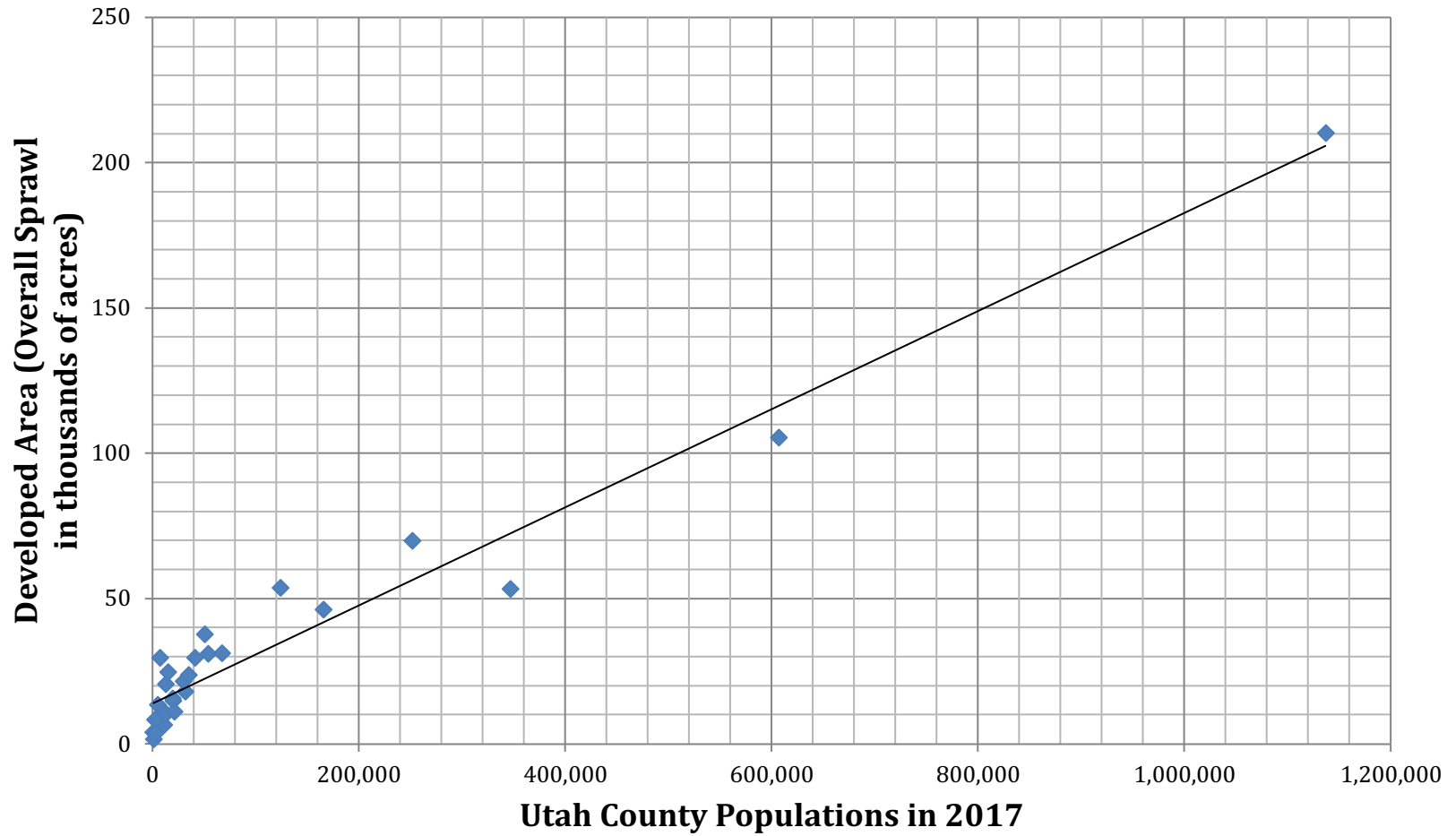
R-value: 0.95

**Utah**

| Utah County   | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Beaver Co.    | 4,678           | 6,421           | 1,743                   | 37                        | 4.8                                    | 8.9                                    | 6.4   | 85                         | 51                                    |
| Box Elder Co. | 34,805          | 53,977          | 19,172                  | 55                        | 23.0                                   | 31.1                                   | 12.7  | 35                         | 100                                   |
| Cache Co.     | 62,017          | 124,236         | 62,219                  | 100                       | 20.9                                   | 53.7                                   | 51.3  | 157                        | 74                                    |
| Carbon Co.    | 23,707          | 20,131          | -3,576                  | -15                       | 11.6                                   | 14.9                                   | 5.2   | 28                         | 0                                     |
| Daggett Co.   | 854             | 1,013           | 159                     | 19                        | 1.9                                    | 4.1                                    | 3.4   | 116                        | 22                                    |
| Davis Co.     | 158,043         | 346,658         | 188,615                 | 119                       | 17.8                                   | 53.3                                   | 55.5  | 199                        | 72                                    |
| Duchesne Co.  | 13,836          | 19,868          | 6,032                   | 44                        | 13.7                                   | 15.8                                   | 3.3   | 15                         | 100                                   |
| Emery Co.     | 13,010          | 10,006          | -3,004                  | -23                       | 8.8                                    | 11.5                                   | 4.2   | 31                         | 0                                     |
| Garfield Co.  | 3,894           | 5,025           | 1,131                   | 29                        | 4.5                                    | 13.5                                   | 14.1  | 200                        | 23                                    |
| Grand Co.     | 8,249           | 9,589           | 1,340                   | 16                        | 8.6                                    | 10.8                                   | 3.4   | 26                         | 66                                    |

| Utah County   | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|---------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Iron Co.      | 18,294          | 50,761          | 32,467                  | 177                       | 14.4                                   | 37.8                                   | 36.6  | 163                        | 100                                   |
| Juab Co.      | 5,711           | 11,293          | 5,582                   | 98                        | 5.1                                    | 6.7                                    | 2.5   | 31                         | 100                                   |
| Kane Co.      | 4,258           | 7,520           | 3,262                   | 77                        | 25.6                                   | 29.7                                   | 6.4   | 16                         | 100                                   |
| Millard Co.   | 10,166          | 12,821          | 2,655                   | 26                        | 12.8                                   | 20.6                                   | 12.2  | 61                         | 49                                    |
| Morgan Co.    | 5,064           | 11,829          | 6,765                   | 134                       | 6.3                                    | 9.9                                    | 5.6   | 57                         | 100                                   |
| Piute Co.     | 1,350           | 1,407           | 57                      | 4                         | 1.3                                    | 1.7                                    | 0.6   | 31                         | 15                                    |
| Rich Co.      | 2,405           | 2,395           | -10                     | 0                         | 6.6                                    | 8.4                                    | 2.8   | 27                         | 0                                     |
| Salt Lake Co. | 657,401         | 1,136,719       | 479,318                 | 73                        | 116.7                                  | 210.3                                  | 146.3   | 80                         | 93                                    |
| San Juan Co.  | 12,337          | 15,277          | 2,940                   | 24                        | 18.4                                   | 24.8                                   | 10.0  | 35                         | 72                                    |
| Sanpete Co.   | 15,517          | 29,921          | 14,404                  | 93                        | 16.6                                   | 21.6                                   | 7.8   | 30                         | 100                                   |
| Sevier Co.    | 15,477          | 21,292          | 5,815                   | 38                        | 7.1                                    | 11.2                                   | 6.4   | 58                         | 70                                    |
| Summit Co.    | 11,316          | 41,330          | 30,014                  | 265                       | 11.6                                   | 29.7                                   | 28.3  | 156                        | 100                                   |

| Utah County             | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Tooele Co.              | 27,401           | 67,486           | 40,085                  | 146                       | 12.5                                   | 31.3                                   | 29.4  | 150                        | 98                                    |
| Uintah Co.              | 24,372           | 35,228           | 10,856                  | 45                        | 17.7                                   | 23.8                                   | 9.5   | 34                         | 100                                   |
| Utah Co.                | 232,684          | 606,742          | 374,058                 | 161                       | 30.8                                   | 105.5                                  | 116.7   | 243                        | 78                                    |
| Wasatch Co.             | 9,103            | 31,890           | 22,787                  | 250                       | 7.0                                    | 18.1                                   | 17.3  | 159                        | 100                                   |
| Washington Co.          | 29,472           | 165,929          | 136,457                 | 463                       | 11.1                                   | 46.3                                   | 55.0  | 317                        | 100                                   |
| Wayne Co.               | 2,035            | 2,702            | 667                     | 33                        | 2.3                                    | 3.6                                    | 2.0   | 57                         | 63                                    |
| Weber Co.               | 150,858          | 251,576          | 100,718                 | 67                        | 32.9                                   | 69.9                                   | 57.8  | 112                        | 68                                    |
| <b>Totals</b>           | <b>1,558,314</b> | <b>3,101,042</b> | <b>1,542,728</b>        | <b>99</b>                 |  |  | <b>712.7</b>                                      | <b>97</b>                  | <b>100</b>                            |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>82</b>                             |



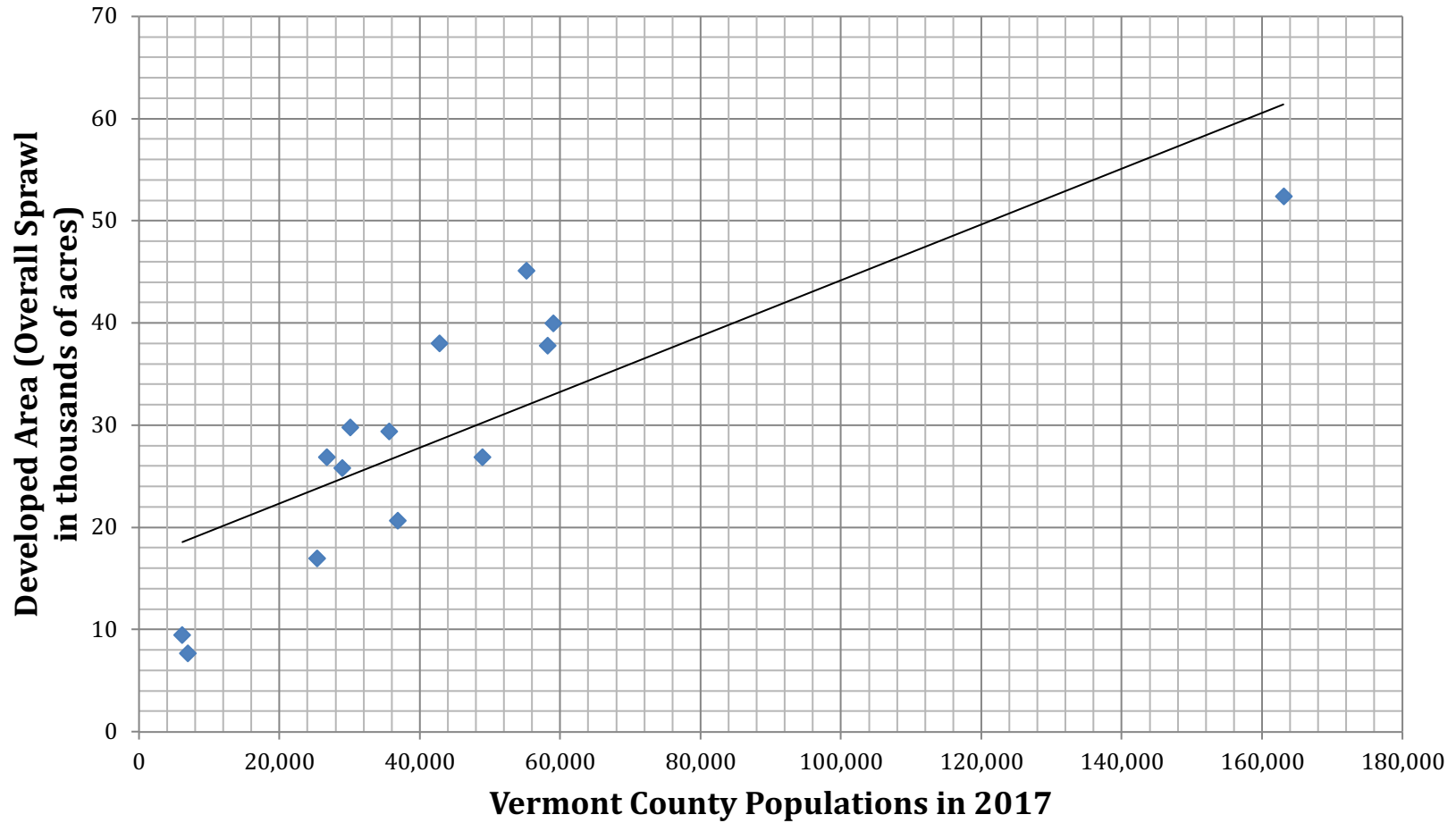
**Scatter Plot for Utah Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

R-value: 0.97

**Vermont**

| Vermont County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Addison Co.    | 29,932          | 36,900          | 6,968                   | 23                        | 12.9                                   | 20.7                                   | 12.2  | 60                         | 44                                    |
| Bennington Co. | 34,084          | 35,675          | 1,591                   | 5                         | 17.5                                   | 29.4                                   | 18.6  | 68                         | 9                                     |
| Caledonia Co.  | 25,772          | 30,141          | 4,369                   | 17                        | 20.0                                   | 29.8                                   | 15.3  | 49                         | 39                                    |
| Chittenden Co. | 118,431         | 163,031         | 44,600                  | 38                        | 31.2                                   | 52.4                                   | 33.1  | 68                         | 62                                    |
| Essex Co.      | 6,154           | 6,184           | 30                      | 0                         | 7.0                                    | 9.5                                    | 3.9   | 36                         | 2                                     |
| Franklin Co.   | 35,438          | 48,969          | 13,531                  | 38                        | 15.7                                   | 26.9                                   | 17.5  | 71                         | 60                                    |
| Grand Isle Co. | 4,794           | 6,975           | 2,181                   | 45                        | 4.9                                    | 7.7                                    | 4.4   | 57                         | 83                                    |
| Lamoille Co.   | 17,045          | 25,360          | 8,315                   | 49                        | 9.7                                    | 17.0                                   | 11.4  | 75                         | 71                                    |
| Orange Co.     | 23,185          | 28,964          | 5,779                   | 25                        | 18.7                                   | 25.8                                   | 11.1  | 38                         | 69                                    |
| Orleans Co.    | 23,384          | 26,811          | 3,427                   | 15                        | 17.3                                   | 26.9                                   | 15.0  | 55                         | 31                                    |

| <b>Vermont County</b>   | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Rutland Co.             | 58,283                 | 59,006                 | 723                            | 1                                | 28.6  | 40.0  | 17.8   | 40                                | 4  |
| Washington Co.          | 53,085                 | 58,253                 | 5,168                          | 10                               | 27.5  | 37.8  | 16.1   | 37                                | 29   |
| Windham Co.             | 37,686                 | 42,851                 | 5,165                          | 14                               | 23.0  | 38.0  | 23.4   | 65                                | 26   |
| Windsor Co.             | 51,835                 | 55,224                 | 3,389                          | 7                                | 29.6  | 45.1  | 24.2   | 52                                | 15   |
| <b>Totals</b>           | <b>519,108</b>         | <b>624,344</b>         | <b>105,236</b>                 | <b>20</b>                        | 12.9  | 20.7  | <b>224.1</b>   | <b>54</b>                         | 42   |
| <b>Weighted Average</b> |                        |                        |                                |                                  |   |   |  |                                   | <b>37</b>                                    |



**Scatter Plot for Vermont County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

R-value: 0.81

**Virginia**

| Virginia County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Accomack Co.    | 31,264          | 32,685          | 1,421                   | 5                         | 16.3                                   | 27.5                                   | 17.5  | 69                         | 8                                     |
| Albemarle Co.   | 57,803          | 107,768         | 49,965                  | 86                        | 28.2                                   | 54.9                                   | 41.7  | 95                         | 94                                    |
| Alleghany Co.*  | 18,930          | 15,128          | -3,802                  | -20                       | 11.7                                   | 14.3                                   | 4.1   | 22                         | 0                                     |
| Amelia Co.      | 8,301           | 12,980          | 4,679                   | 56                        | 7.5                                    | 11.1                                   | 5.6   | 48                         | 100                                   |
| Amherst Co.     | 29,143          | 31,863          | 2,720                   | 9                         | 14.9                                   | 22.1                                   | 11.3  | 48                         | 23                                    |
| Appomattox Co.  | 12,031          | 15,723          | 3,692                   | 31                        | 9.9                                    | 16.4                                   | 10.2  | 66                         | 53                                    |
| Arlington Co.   | 157,834         | 234,647         | 76,813                  | 49                        | 5.5                                    | 5.7                                    | 0.3   | 4                          | 100                                   |
| Augusta Co.     | 48,452          | 75,177          | 26,725                  | 55                        | 30.2                                   | 57.2                                   | 42.2  | 89                         | 69                                    |
| Bath Co.        | 5,410           | 4,266           | -1,144                  | -21                       | 2.3                                    | 2.8                                    | 0.8   | 22                         | 0                                     |
| Bedford Co.*    | 42,582          | 78,378          | 35,796                  | 84                        | 37.3                                   | 65.0                                   | 43.3  | 74                         | 100                                   |

| <b>Virginia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Bland Co.              | 6,520                  | 6,354                  | -166                           | -3                               | 5.0   | 6.9   | 3.0  | 38                                | 0  |
| Botetourt Co.          | 23,406                 | 33,313                 | 9,907                          | 42                               | 11.6  | 18.6  | 10.9   | 60                                | 75   |
| Brunswick Co.          | 15,549                 | 16,570                 | 1,021                          | 7                                | 9.7   | 13.2  | 5.5  | 36                                | 21   |
| Buchanan Co.           | 37,639                 | 21,604                 | -16,035                        | -43                              | 11.8  | 16.6  | 7.5  | 41                                | 0  |
| Buckingham Co.         | 11,634                 | 17,038                 | 5,404                          | 46                               | 5.4   | 11.9  | 10.2   | 120                               | 48   |
| Campbell Co.           | 45,885                 | 55,326                 | 9,441                          | 21                               | 21.8  | 33.6  | 18.4   | 54                                | 43   |
| Caroline Co.           | 17,981                 | 30,432                 | 12,451                         | 69                               | 10.9  | 22.3  | 17.8   | 105                               | 74   |
| Carroll Co.            | 27,516                 | 29,812                 | 2,296                          | 8                                | 16.3  | 28.6  | 19.2   | 75                                | 14   |
| Charles City Co.       | 6,659                  | 7,026                  | 367                            | 6                                | 1.9   | 5.3   | 5.3  | 179                               | 5  |
| Charlotte Co.          | 12,065                 | 12,077                 | 12                             | 0                                | 12.7  | 15.4  | 4.2  | 21                                | 1  |
| Chesterfield Co.       | 152,101                | 343,276                | 191,175                        | 126                              | 62.1  | 119.1   | 89.1   | 92                                | 100  |
| Clarke Co.             | 10,288                 | 14,454                 | 4,166                          | 40                               | 6.2   | 10.2  | 6.3  | 65                                | 68   |

| Virginia County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Craig Co.       | 4,004           | 5,062           | 1,058                   | 26                        | 2.1                                    | 4.6                                    | 3.9   | 119                        | 30                                    |
| Culpeper Co.    | 23,053          | 51,235          | 28,182                  | 122                       | 11.9                                   | 24.0                                   | 18.9  | 102                        | 100                                   |
| Cumberland Co.  | 7,799           | 9,828           | 2,029                   | 26                        | 6.7                                    | 11.6                                   | 7.7   | 73                         | 42                                    |
| Dickenson Co.   | 19,985          | 14,722          | -5,263                  | -26                       | 8.9                                    | 14.5                                   | 8.8   | 63                         | 0                                     |
| Dinwiddie Co.   | 22,093          | 28,630          | 6,537                   | 30                        | 7.6                                    | 18.5                                   | 17.0  | 143                        | 29                                    |
| Essex Co.       | 8,839           | 10,969          | 2,130                   | 24                        | 5.4                                    | 10.4                                   | 7.8   | 93                         | 33                                    |
| Fairfax Co.*    | 652,222         | 1,162,973       | 510,751                 | 78                        | 138.1                                  | 211.8                                  | 115.2   | 53                         | 100                                   |
| Fauquier Co.    | 37,632          | 69,547          | 31,915                  | 85                        | 25.5                                   | 47.9                                   | 35.0  | 88                         | 97                                    |
| Floyd Co.       | 11,674          | 15,758          | 4,084                   | 35                        | 9.1                                    | 15.2                                   | 9.5   | 67                         | 58                                    |
| Fluvanna Co.    | 10,437          | 26,480          | 16,043                  | 154                       | 10.6                                   | 22.3                                   | 18.3  | 110                        | 100                                   |
| Franklin Co.    | 36,165          | 56,315          | 20,150                  | 56                        | 24.8                                   | 45.8                                   | 32.8  | 85                         | 72                                    |
| Frederick Co.   | 35,744          | 86,456          | 50,712                  | 142                       | 23.9                                   | 42.8                                   | 29.5  | 79                         | 100                                   |

| Virginia County   | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Giles Co.         | 17,602          | 16,754          | -848                    | -5                        | 5.7                                    | 10.3                                   | 7.2   | 81                         | 0                                     |
| Gloucester Co.    | 21,658          | 37,295          | 15,637                  | 72                        | 11.3                                   | 23.2                                   | 18.6  | 105                        | 76                                    |
| Goochland Co.     | 11,993          | 22,703          | 10,710                  | 89                        | 10.7                                   | 24.3                                   | 21.3  | 127                        | 78                                    |
| Grayson Co.       | 16,663          | 15,697          | -966                    | -6                        | 9.6                                    | 16.5                                   | 10.8  | 72                         | 0                                     |
| Greene Co.        | 8,207           | 19,593          | 11,386                  | 139                       | 12.1                                   | 16.9                                   | 7.5   | 40                         | 100                                   |
| Greensville Co.   | 9,705           | 11,569          | 1,864                   | 19                        | 6.3                                    | 12.6                                   | 9.8   | 100                        | 25                                    |
| Halifax Co.       | 37,075          | 34,575          | -2,500                  | -7                        | 24.3                                   | 33.3                                   | 14.1  | 37                         | 0                                     |
| Hanover Co.       | 51,363          | 105,674         | 54,311                  | 106                       | 22.5                                   | 72.8                                   | 78.6  | 224                        | 61                                    |
| Henrico Co.       | 186,277         | 327,559         | 141,282                 | 76                        | 48.3                                   | 89.8                                   | 64.8  | 86                         | 91                                    |
| Henry Co.         | 57,566          | 51,346          | -6,220                  | -11                       | 33.6                                   | 49.9                                   | 25.5  | 49                         | 0                                     |
| Highland Co.      | 2,774           | 2,217           | -557                    | -20                       | 3.0                                    | 3.7                                    | 1.1   | 23                         | 0                                     |
| Isle of Wight Co. | 21,899          | 36,571          | 14,672                  | 67                        | 8.7                                    | 16.7                                   | 12.5  | 92                         | 79                                    |

| <b>Virginia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| James City Co.         | 24,626                 | 75,274                 | 50,648                         | 206                              | 11.8  | 37.7  | 40.5   | 219                               | 96   |
| King and Queen Co.     | 5,915                  | 6,999                  | 1,084                          | 18                               | 4.9   | 12.1  | 11.3   | 147                               | 19   |
| King George Co.        | 10,484                 | 26,337                 | 15,853                         | 151                              | 5.6   | 15.7  | 15.8   | 180                               | 89   |
| King William Co.       | 9,635                  | 16,684                 | 7,049                          | 73                               | 5.0   | 12.6  | 11.9   | 152                               | 59   |
| Lancaster Co.          | 10,223                 | 10,725                 | 502                            | 5                                | 5.6   | 14.2  | 13.4   | 154                               | 5  |
| Lee Co.                | 26,199                 | 23,900                 | -2,299                         | -9                               | 9.9   | 15.9  | 9.4  | 61                                | 0  |
| Loudoun Co.            | 60,142                 | 397,049                | 336,907                        | 560                              | 21.4  | 91.5  | 109.5  | 328                               | 100  |
| Louisa Co.             | 18,265                 | 35,912                 | 17,647                         | 97                               | 17.8  | 42.1  | 38.0   | 137                               | 79   |
| Lunenburg Co.          | 11,986                 | 12,333                 | 347                            | 3                                | 9.6   | 13.9  | 6.7  | 45                                | 8  |
| Madison Co.            | 10,310                 | 13,212                 | 2,902                          | 28                               | 8.0   | 11.5  | 5.5  | 44                                | 68   |
| Mathews Co.            | 8,080                  | 8,709                  | 629                            | 8                                | 4.9   | 8.4   | 5.5  | 71                                | 14   |

| <b>Virginia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Mecklenburg Co.        | 29,281                 | 30,693                 | 1,412                          | 5                                | 16.5  | 27.3  | 16.9   | 65                                | 9  |
| Middlesex Co.          | 7,829                  | 10,625                 | 2,796                          | 36                               | 7.5   | 12.0  | 7.0  | 60                                | 65   |
| Montgomery Co.         | 65,398                 | 98,142                 | 32,744                         | 50                               | 22.2  | 36.8  | 22.8   | 66                                | 80   |
| Nelson Co.             | 12,481                 | 14,800                 | 2,319                          | 19                               | 6.8   | 12.5  | 8.9  | 84                                | 28   |
| New Kent Co.           | 8,918                  | 21,638                 | 12,720                         | 143                              | 5.9   | 20.4  | 22.7   | 246                               | 71   |
| Northampton Co.        | 14,145                 | 11,872                 | -2,273                         | -16                              | 9.6   | 15.9  | 9.8  | 66                                | 0  |
| Northumberland Co.     | 9,940                  | 12,271                 | 2,331                          | 23                               | 3.9   | 13.7  | 15.3   | 251                               | 17   |
| Nottoway Co.           | 14,611                 | 15,432                 | 821                            | 6                                | 7.5   | 10.5  | 4.7  | 40                                | 16   |
| Orange Co.             | 18,398                 | 35,870                 | 17,472                         | 95                               | 15.3  | 27.9  | 19.7   | 82                                | 100  |
| Page Co.               | 19,665                 | 23,784                 | 4,119                          | 21                               | 7.1   | 15.7  | 13.4   | 121                               | 24   |
| Patrick Co.            | 17,454                 | 17,713                 | 259                            | 1                                | 9.8   | 17.5  | 12.0   | 79                                | 3  |

| Virginia County    | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Pittsylvania Co.   | 54,982          | 61,309          | 6,327                   | 12                        | 27.3                                   | 46.0                                   | 29.2  | 68                         | 21                                    |
| Powhatan Co.       | 13,136          | 28,716          | 15,580                  | 119                       | 14.8                                   | 26.2                                   | 17.8  | 77                         | 100                                   |
| Prince Edward Co.  | 16,709          | 22,678          | 5,969                   | 36                        | 13.1                                   | 19.0                                   | 9.2   | 45                         | 82                                    |
| Prince George Co.  | 25,467          | 38,006          | 12,539                  | 49                        | 7.0                                    | 25.7                                   | 29.2  | 267                        | 31                                    |
| Prince William Co. | 158,130         | 463,069         | 304,939                 | 193                       | 50.5                                   | 116.1                                  | 102.5   | 130                        | 100                                   |
| Pulaski Co.        | 35,304          | 34,225          | -1,079                  | -3                        | 15.5                                   | 23.6                                   | 12.7  | 52                         | 0                                     |
| Rappahannock Co.   | 5,954           | 7,393           | 1,439                   | 24                        | 7.5                                    | 12.3                                   | 7.5   | 64                         | 44                                    |
| Richmond Co.       | 6,958           | 8,889           | 1,931                   | 28                        | 2.7                                    | 8.0                                    | 8.3   | 196                        | 23                                    |
| Roanoke Co.        | 73,475          | 93,939          | 20,464                  | 28                        | 20.3                                   | 37.2                                   | 26.4  | 83                         | 41                                    |
| Rockbridge Co.*    | 24,986          | 29,822          | 4,836                   | 19                        | 18.4                                   | 25.6                                   | 11.3  | 39                         | 54                                    |
| Rockingham Co.     | 53,044          | 80,397          | 27,353                  | 52                        | 25.9                                   | 43.8                                   | 28.0  | 69                         | 79                                    |

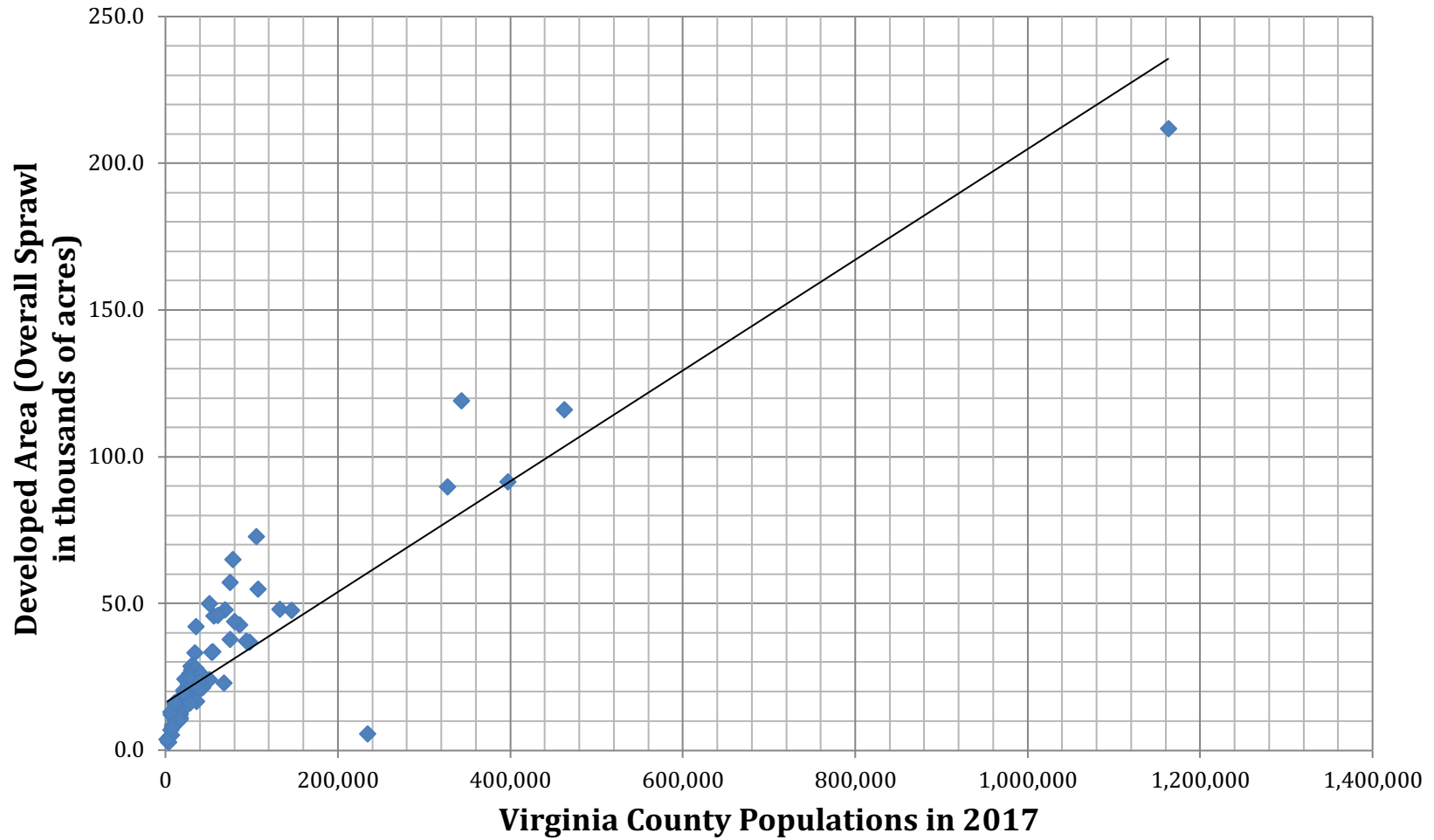
| Virginia County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Russell Co.      | 31,921          | 27,046          | -4,875                  | -15                       | 16.3                                   | 22.9                                   | 10.3  | 40                         | 0                                     |
| Scott Co.        | 24,863          | 21,893          | -2,970                  | -12                       | 12.2                                   | 19.6                                   | 11.6  | 61                         | 0                                     |
| Shenandoah Co.   | 28,173          | 43,276          | 15,103                  | 54                        | 14.5                                   | 21.5                                   | 10.9  | 48                         | 100                                   |
| Smyth Co.        | 33,208          | 30,731          | -2,477                  | -7                        | 17.8                                   | 24.2                                   | 10.0  | 36                         | 0                                     |
| Southampton Co.  | 17,911          | 17,841          | -70                     | 0                         | 7.2                                    | 12.4                                   | 8.1   | 72                         | 0                                     |
| Spotsylvania Co. | 35,014          | 132,739         | 97,725                  | 279                       | 12.2                                   | 48.0                                   | 55.9  | 293                        | 97                                    |
| Stafford Co.     | 43,318          | 146,792         | 103,474                 | 239                       | 21.4                                   | 47.7                                   | 41.1  | 123                        | 100                                   |
| Surry Co.        | 5,977           | 6,503           | 526                     | 9                         | 6.4                                    | 13.0                                   | 10.3  | 103                        | 12                                    |
| Sussex Co.       | 10,615          | 11,379          | 764                     | 7                         | 9.3                                    | 16.3                                   | 10.9  | 75                         | 12                                    |
| Tazewell Co.     | 50,889          | 41,303          | -9,586                  | -19                       | 17.7                                   | 26.0                                   | 13.0  | 47                         | 0                                     |
| Warren Co.       | 21,757          | 39,409          | 17,652                  | 81                        | 6.1                                    | 23.3                                   | 26.9  | 282                        | 44                                    |
| Washington Co.   | 46,166          | 54,179          | 8,013                   | 17                        | 22.4                                   | 33.4                                   | 17.2  | 49                         | 40                                    |

| Virginia County       | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Westmoreland Co.      | 14,212          | 17,725          | 3,513                   | 25                        | 4.5                                    | 11.0                                   | 10.2  | 144                        | 25                                    |
| Wise Co.              | 43,878          | 38,574          | -5,304                  | -12                       | 14.2                                   | 21.2                                   | 10.9  | 49                         | 0                                     |
| Wythe Co.             | 25,594          | 28,829          | 3,235                   | 13                        | 12.1                                   | 16.0                                   | 6.1   | 32                         | 43                                    |
| York Co.              | 36,031          | 68,022          | 31,991                  | 89                        | 11.8                                   | 22.9                                   | 17.3  | 94                         | 96                                    |
| Alexandria city       | 105,297         | 159,215         | 53,918                  | 51                        | 3.5                                    | 4.4                                    | 1.4   | 26                         | 100                                   |
| Bristol city          | 19,242          | 16,880          | -2,362                  | -12                       | 1.0                                    | 2.9                                    | 3.0   | 190                        | 0                                     |
| Buena Vista city      | 6,713           | 6,482           | -231                    | -3                        | 0.6                                    | 1.0                                    | 0.6   | 67                         | 0                                     |
| Charlottesville city  | 40,273          | 47,463          | 7,190                   | 18                        | 9.4                                    | 9.4                                    | 0.0   | 0                          | 0                                     |
| Chesapeake city       | 118,533         | 240,143         | 121,610                 | 103                       | 29.2                                   | 72.7                                   | 68.0  | 149                        | 77                                    |
| Colonial Heights city | 16,700          | 17,424          | 724                     | 4                         | 5.7                                    | 8.8                                    | 4.8   | 54                         | 10                                    |
| Covington city        | 8,455           | 5,576           | -2,879                  | -34                       | 0.6                                    | 1.2                                    | 0.9   | 100                        | 0                                     |

| <b>Virginia County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Danville city          | 55,829                 | 41,044                 | -14,785                        | -26                              | 21.3  | 28.0  | 10.5   | 31                                | 0  |
| Emporia city           | 5,755                  | 5,467                  | -288                           | -5                               | 0.5   | 0.6   | 0.2  | 20                                | 0  |
| Fairfax city           | 19,483                 | 23,435                 | 3,952                          | 20                               | 1.6   | 2.3   | 1.1  | 44                                | 51   |
| Franklin city          | 7,634                  | 8,145                  | 511                            | 7                                | 7.4   | 8.7   | 2.0  | 18                                | 40   |
| Fredericksburg city    | 17,259                 | 28,498                 | 11,239                         | 65                               | 0.5   | 1.1   | 0.9  | 120                               | 64   |
| Galax city             | 6,630                  | 6,484                  | -146                           | -2                               | 7.0   | 8.2   | 1.9  | 17                                | 0  |
| Hampton city           | 125,946                | 134,725                | 8,779                          | 7                                | 20.9  | 29.3  | 13.1   | 40                                | 20   |
| Harrisonburg city      | 26,042                 | 53,644                 | 27,602                         | 106                              | 4.6   | 5.8   | 1.9  | 26                                | 100  |
| Hopewell city          | 23,844                 | 22,505                 | -1,339                         | -6                               | 7.5   | 8.5   | 1.6  | 13                                | 0  |
| Lynchburg city         | 67,517                 | 80,523                 | 13,006                         | 19                               | 19.5  | 26.7  | 11.3   | 37                                | 56   |
| Manassas city          | 17,002                 | 41,141                 | 24,139                         | 142                              | 9.4   | 9.4   | 0.0  | 0                                 | 0  |

| Virginia County    | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|--------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Manassas Park city | 6,443           | 17,149          | 10,706                  | 166                       | 1.8                                    | 1.8                                    | 0.0   | 0                          | 0                                     |
| Martinsville city  | 17,715          | 12,823          | -4,892                  | -28                       | 7.6                                    | 9.8                                    | 3.4   | 29                         | 0                                     |
| Newport News city  | 151,851         | 179,447         | 27,596                  | 18                        | 31.0                                   | 33.6                                   | 4.1   | 8                          | 100                                   |
| Norfolk city       | 265,322         | 244,543         | -20,779                 | -8                        | 31.7                                   | 29.8                                   | -3.0  | -6                         | 100                                   |
| Norton city        | 4,697           | 3,918           | -779                    | -17                       | 2.8                                    | 3.4                                    | 0.9   | 21                         | 0                                     |
| Petersburg city    | 40,484          | 31,137          | -9,347                  | -23                       | 6.6                                    | 10.4                                   | 5.9   | 58                         | 0                                     |
| Poquoson city      | 9,392           | 12,039          | 2,647                   | 28                        | 4.5                                    | 5.1                                    | 0.9   | 13                         | 100                                   |
| Portsmouth city    | 106,058         | 94,838          | -11,220                 | -11                       | 15.4                                   | 18.2                                   | 4.4   | 18                         | 0                                     |
| Radford city       | 13,898          | 17,484          | 3,586                   | 26                        | 0.1                                    | 0.6                                    | 0.8   | 500                        | 13                                    |
| Richmond city      | 218,146         | 227,230         | 9,084                   | 4                         | 31.7                                   | 42.2                                   | 16.4  | 33                         | 14                                    |
| Roanoke city       | 100,667         | 98,986          | -1,681                  | -2                        | 24.2                                   | 23.0                                   | -1.9  | -5                         | 33                                    |

| Virginia County         | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Salem city              | 24,034           | 25,373           | 1,339                   | 6                         | 4.6                                    | 7.4                                    | 4.4   | 61                         | 11                                    |
| Staunton city           | 24,796           | 24,325           | -471                    | -2                        | 3.2                                    | 4.3                                    | 1.7   | 34                         | 0                                     |
| Suffolk city            | 47,533           | 90,108           | 42,575                  | 90                        | 16.3                                   | 32.2                                   | 24.8  | 98                         | 94                                    |
| Virginia Beach city     | 281,910          | 449,896          | 167,986                 | 60                        | 56.0                                   | 99.4                                   | 67.8  | 78                         | 81                                    |
| Waynesboro city         | 18,453           | 22,242           | 3,789                   | 21                        | 7.1                                    | 7.2                                    | 0.2   | 1                          | 100                                   |
| Williamsburg city       | 10,226           | 14,994           | 4,768                   | 47                        | 5.4                                    | 5.9                                    | 0.8   | 9                          | 100                                   |
| Winchester city         | 19,927           | 28,178           | 8,251                   | 41                        | 2.6                                    | 3.4                                    | 1.3   | 31                         | 100                                   |
| <b>Totals</b>           | <b>5,492,785</b> | <b>8,463,587</b> | <b>2,970,802</b>        | <b>54</b>                 | <b>1,838.4</b>                         | <b>3,233.5</b>                         | <b>2,179.8</b>                                    | <b>76</b>                  | <b>77</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>66</b>                             |



**Scatter Plot for Virginia County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.91**

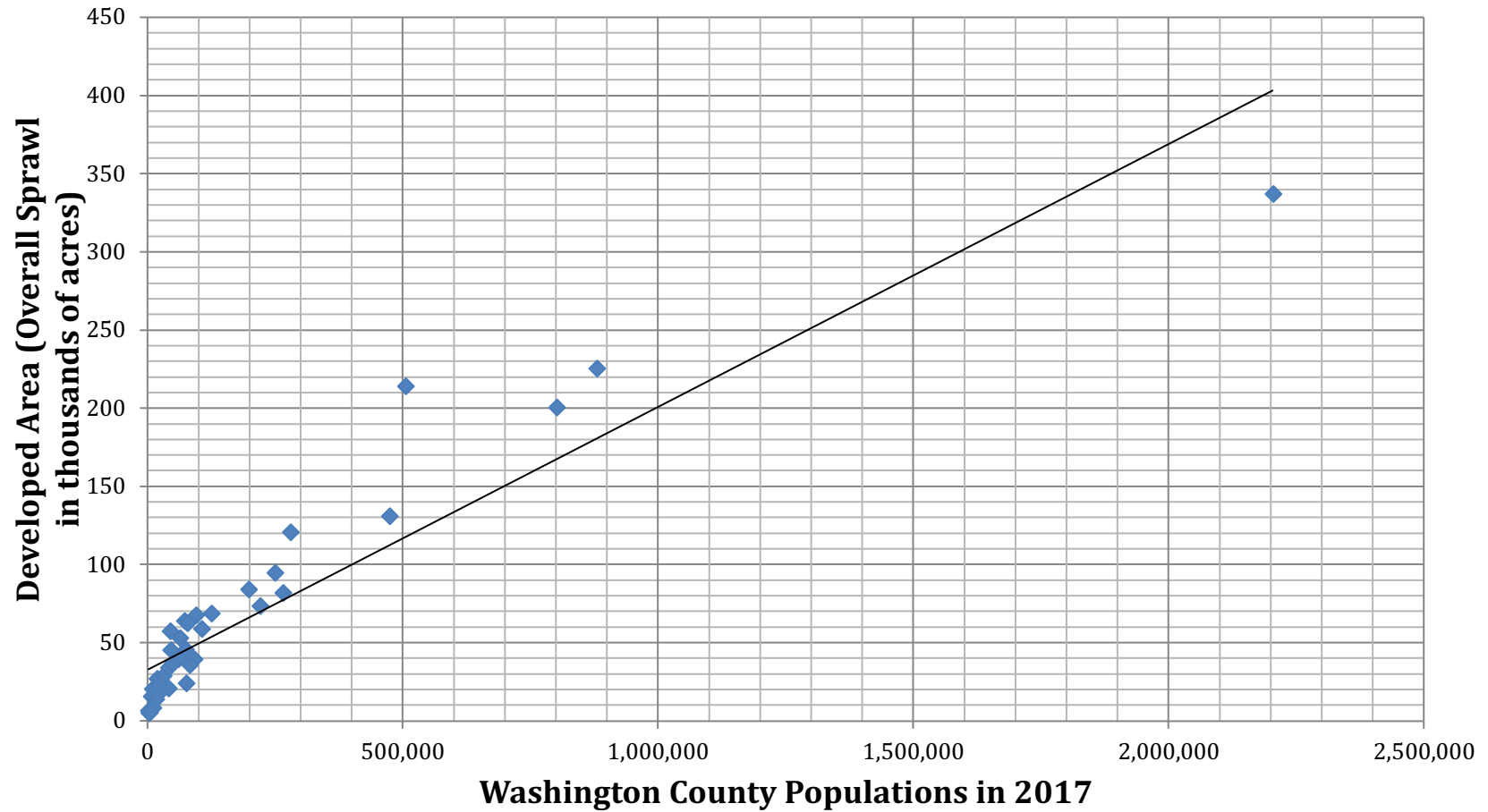
**Washington**

| <b>Washington County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|--------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adams Co.                | 13,240                 | 19,651                 | 6,411                          | 48                               | 22.9  | 27.2  | 6.7  | 19                                | 100  |
| Asotin Co.               | 16,998                 | 22,509                 | 5,511                          | 32                               | 12.9  | 17.9  | 7.8  | 39                                | 86   |
| Benton Co.               | 116,202                | 198,200                | 81,998                         | 71                               | 57.2  | 84.4  | 42.5   | 48                                | 100  |
| Chelan Co.               | 46,530                 | 76,298                 | 29,768                         | 64                               | 11.8  | 24.4  | 19.7   | 107                               | 68   |
| Clallam Co.              | 51,217                 | 75,637                 | 24,420                         | 48                               | 33.4  | 45.8  | 19.4   | 37                                | 100  |
| Clark Co.                | 199,472                | 474,381                | 274,909                        | 138                              | 65.4  | 131.2   | 102.8  | 101                               | 100  |
| Columbia Co.             | 4,030                  | 4,002                  | -28                            | -1                               | 4.8   | 5.2   | 0.6  | 8                                 | 0  |
| Cowlitz Co.              | 79,006                 | 106,805                | 27,799                         | 35                               | 38.4  | 59.0  | 32.2   | 54                                | 70   |
| Douglas Co.              | 23,092                 | 42,027                 | 18,935                         | 82                               | 12.8  | 20.8  | 12.5   | 63                                | 100  |
| Ferry Co.                | 5,904                  | 7,576                  | 1,672                          | 28                               | 13.1  | 15.9  | 4.4  | 21                                | 100  |
| Franklin Co.             | 36,877                 | 91,896                 | 55,019                         | 149                              | 21.8  | 39.7  | 28.0   | 82                                | 100  |

| Washington County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Garfield Co.      | 2,424           | 2,215           | -209                    | -9                        | 6.1                                    | 6.6                                    | 0.8   | 8                          | 0                                     |
| Grant Co.         | 49,768          | 95,357          | 45,589                  | 92                        | 53.7                                   | 67.7                                   | 21.9  | 26                         | 100                                   |
| Grays Harbor Co.  | 65,659          | 72,490          | 6,831                   | 10                        | 46.0                                   | 64.3                                   | 28.6  | 40                         | 30                                    |
| Island Co.        | 45,505          | 83,250          | 37,745                  | 83                        | 14.7                                   | 36.0                                   | 33.3  | 145                        | 67                                    |
| Jefferson Co.     | 16,794          | 31,210          | 14,416                  | 86                        | 15.4                                   | 28.9                                   | 21.1  | 88                         | 98                                    |
| King Co.          | 1,311,370       | 2,203,836       | 892,466                 | 68                        | 233.3                                  | 337.0                                  | 162.0   | 44                         | 100                                   |
| Kitsap Co.        | 155,059         | 266,289         | 111,230                 | 72                        | 39.4                                   | 81.9                                   | 66.4  | 108                        | 74                                    |
| Kittitas Co.      | 25,021          | 46,176          | 21,155                  | 85                        | 30.5                                   | 45.6                                   | 23.6  | 50                         | 100                                   |
| Klickitat Co.     | 16,442          | 21,751          | 5,309                   | 32                        | 13.4                                   | 17.7                                   | 6.7   | 32                         | 100                                   |
| Lewis Co.         | 57,175          | 78,320          | 21,145                  | 37                        | 40.6                                   | 62.6                                   | 34.4  | 54                         | 73                                    |
| Lincoln Co.       | 9,532           | 10,585          | 1,053                   | 11                        | 19.0                                   | 20.4                                   | 2.2   | 7                          | 100                                   |
| Mason Co.         | 32,819          | 63,740          | 30,921                  | 94                        | 35.7                                   | 53.1                                   | 27.2  | 49                         | 100                                   |

| Washington County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Okanogan Co.      | 31,978          | 41,915          | 9,937                   | 31                        | 27.2                                   | 34.2                                   | 10.9  | 26                         | 100                                   |
| Pacific Co.       | 17,849          | 21,742          | 3,893                   | 22                        | 18.0                                   | 22.9                                   | 7.7   | 27                         | 82                                    |
| Pend Oreille Co.  | 8,699           | 13,358          | 4,659                   | 54                        | 11.8                                   | 17.2                                   | 8.4   | 46                         | 100                                   |
| Pierce Co.        | 509,976         | 879,654         | 369,678                 | 72                        | 117.5                                  | 225.6                                  | 168.9   | 92                         | 84                                    |
| San Juan Co.      | 8,277           | 16,729          | 8,452                   | 102                       | 6.8                                    | 14.1                                   | 11.4  | 107                        | 96                                    |
| Skagit Co.        | 66,812          | 125,860         | 59,048                  | 88                        | 48.5                                   | 69.0                                   | 32.0  | 42                         | 100                                   |
| Skamania Co.      | 7,581           | 11,809          | 4,228                   | 56                        | 5.4                                    | 8.6                                    | 5.0   | 59                         | 95                                    |
| Snohomish Co.     | 356,563         | 802,089         | 445,526                 | 125                       | 97.9                                   | 200.6                                  | 160.5   | 105                        | 100                                   |
| Spokane Co.       | 347,440         | 505,623         | 158,183                 | 46                        | 166.6                                  | 214.1                                  | 74.2  | 29                         | 100                                   |
| Stevens Co.       | 29,976          | 44,636          | 14,660                  | 49                        | 37.9                                   | 57.5                                   | 30.6  | 52                         | 96                                    |
| Thurston Co.      | 132,109         | 280,269         | 148,160                 | 112                       | 54.5                                   | 120.7                                  | 103.4   | 121                        | 95                                    |
| Wahkiakum Co.     | 3,744           | 4,251           | 507                     | 14                        | 4.1                                    | 5.4                                    | 2.0   | 32                         | 46                                    |

| Washington County       | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Walla Walla Co.         | 48,751           | 60,512           | 11,761                  | 24                        | 29.6                                   | 39.7                                   | 15.8  | 34                         | 74                                    |
| Whatcom Co.             | 109,885          | 221,410          | 111,525                 | 101                       | 45.1                                   | 73.6                                   | 44.5  | 63                         | 100                                   |
| Whitman Co.             | 39,950           | 49,382           | 9,432                   | 24                        | 35.9                                   | 37.2                                   | 2.0   | 4                          | 100                                   |
| Yakima Co.              | 176,825          | 249,922          | 73,097                  | 41                        | 60.2                                   | 94.7                                   | 53.9  | 57                         | 76                                    |
| <b>Totals</b>           | <b>4,276,551</b> | <b>7,423,362</b> | <b>3,146,811</b>        | <b>74</b>                 | <b>1,609.3</b>                         | <b>2,528.4</b>                         | <b>1,436.1</b>                                    | <b>57</b>                  | <b>100</b>                            |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>91</b>                             |



**Scatter Plot for Washington County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.92**

**West Virginia**

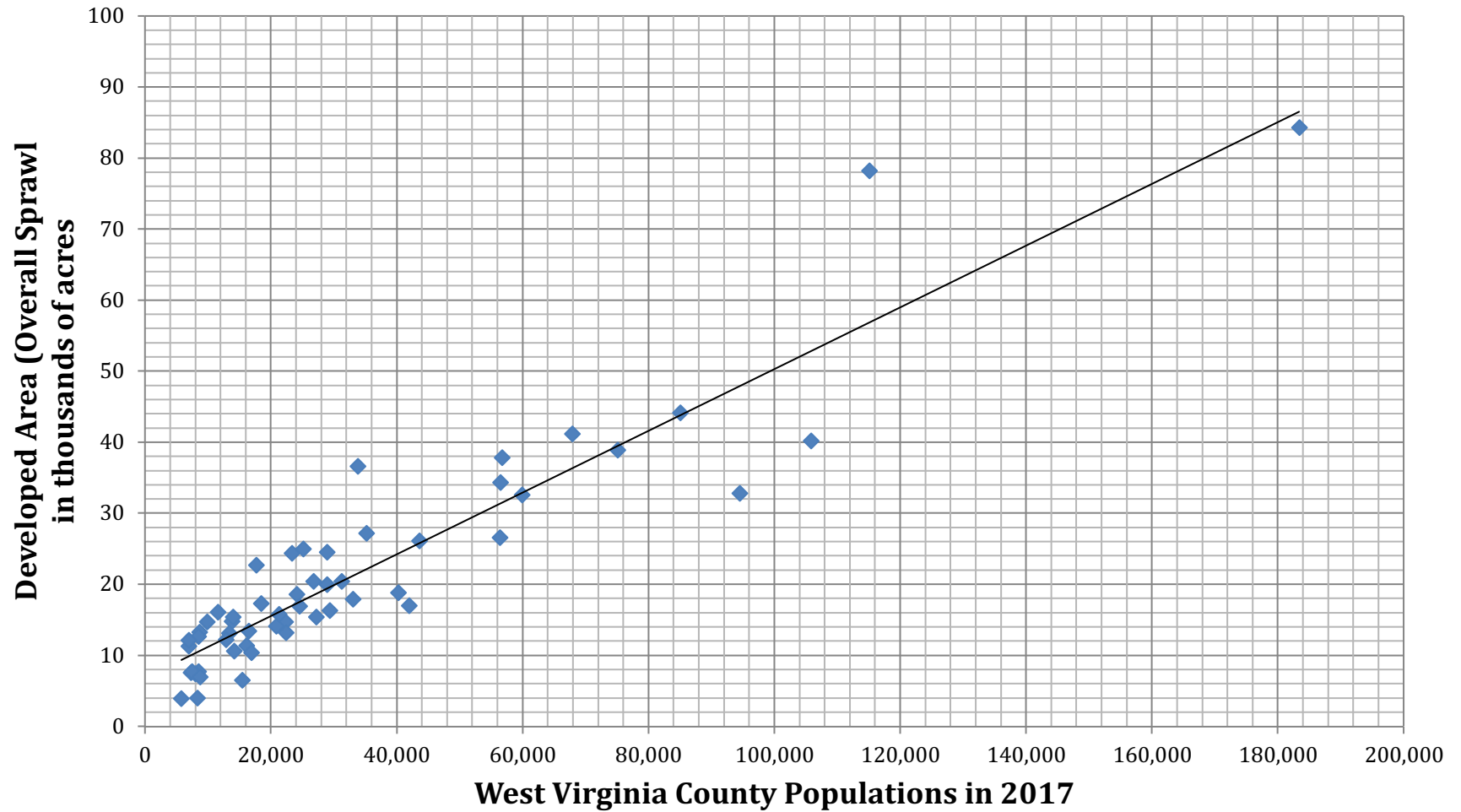
| West Virginia County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Barbour Co.          | 16,734          | 16,515          | -219                    | -1                        | 5.9                                    | 13.4                                   | 11.7  | 127                        | 0                                     |
| Berkeley Co.         | 48,528          | 115,073         | 66,545                  | 137                       | 24.8                                   | 78.2                                   | 83.4  | 215                        | 75                                    |
| Boone Co.            | 30,429          | 22,369          | -8,060                  | -26                       | 7.3                                    | 14.7                                   | 11.6  | 101                        | 0                                     |
| Braxton Co.          | 14,200          | 14,217          | 17                      | 0                         | 7.5                                    | 10.6                                   | 4.8   | 41                         | 0                                     |
| Brooke Co.           | 30,484          | 22,373          | -8,111                  | -27                       | 9.2                                    | 13.2                                   | 6.3   | 43                         | 0                                     |
| Cabell Co.           | 105,808         | 94,452          | -11,356                 | -11                       | 20.7                                   | 32.8                                   | 18.9  | 58                         | 0                                     |
| Calhoun Co.          | 8,431           | 7,310           | -1,121                  | -13                       | 4.8                                    | 7.6                                    | 4.4   | 58                         | 0                                     |
| Clay Co.             | 11,267          | 8,693           | -2,574                  | -23                       | 7.1                                    | 13.3                                   | 9.7   | 87                         | 0                                     |
| Doddridge Co.        | 7,566           | 8,518           | 952                     | 13                        | 5.8                                    | 7.7                                    | 3.0   | 33                         | 42                                    |
| Fayette Co.          | 57,186          | 43,607          | -13,579                 | -24                       | 16.3                                   | 26.1                                   | 15.3  | 60                         | 0                                     |
| Gilmer Co.           | 8,770           | 8,042           | -728                    | -8                        | 5.7                                    | 7.4                                    | 2.7   | 30                         | 0                                     |

| West Virginia County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Grant Co.            | 10,380          | 11,627          | 1,247                   | 12                        | 6.8                                    | 16.1                                   | 14.5  | 137                        | 13                                    |
| Greenbrier Co.       | 37,197          | 35,208          | -1,989                  | -5                        | 15.0                                   | 27.2                                   | 19.1  | 81                         | 0                                     |
| Hampshire Co.        | 15,220          | 23,386          | 8,166                   | 54                        | 15.4                                   | 24.4                                   | 14.1  | 58                         | 93                                    |
| Hancock Co.          | 40,455          | 29,383          | -11,072                 | -27                       | 12.6                                   | 16.3                                   | 5.8   | 29                         | 0                                     |
| Hardy Co.            | 10,171          | 13,849          | 3,678                   | 36                        | 7.0                                    | 14.8                                   | 12.2  | 111                        | 41                                    |
| Harrison Co.         | 77,432          | 67,905          | -9,527                  | -12                       | 26.0                                   | 41.2                                   | 23.8  | 58                         | 0                                     |
| Jackson Co.          | 26,287          | 28,908          | 2,621                   | 10                        | 10.5                                   | 20.0                                   | 14.8  | 90                         | 15                                    |
| Jefferson Co.        | 31,147          | 56,444          | 25,297                  | 81                        | 11.1                                   | 34.3                                   | 36.3  | 209                        | 53                                    |
| Kanawha Co.          | 230,130         | 183,385         | -46,745                 | -20                       | 54.9                                   | 84.3                                   | 45.9  | 54                         | 0                                     |
| Lewis Co.            | 18,886          | 16,178          | -2,708                  | -14                       | 6.5                                    | 11.4                                   | 7.7   | 75                         | 0                                     |
| Lincoln Co.          | 23,780          | 20,872          | -2,908                  | -12                       | 4.5                                    | 14.1                                   | 15.0  | 213                        | 0                                     |
| Logan Co.            | 50,555          | 33,028          | -17,527                 | -35                       | 12.5                                   | 17.9                                   | 8.4   | 43                         | 0                                     |

| West Virginia County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| McDowell Co.         | 48,280          | 18,505          | -29,775                 | -62                       | 11.3                                   | 17.3                                   | 9.4   | 53                         | 0                                     |
| Marion Co.           | 64,960          | 56,349          | -8,611                  | -13                       | 16.6                                   | 26.6                                   | 15.6  | 60                         | 0                                     |
| Marshall Co.         | 40,834          | 31,252          | -9,582                  | -23                       | 12.7                                   | 20.4                                   | 12.0  | 61                         | 0                                     |
| Mason Co.            | 27,026          | 26,806          | -220                    | -1                        | 11.5                                   | 20.4                                   | 13.9  | 77                         | 0                                     |
| Mercer Co.           | 74,380          | 59,869          | -14,511                 | -20                       | 20.2                                   | 32.6                                   | 19.4  | 61                         | 0                                     |
| Mineral Co.          | 27,647          | 27,223          | -424                    | -2                        | 9.9                                    | 15.4                                   | 8.6   | 56                         | 0                                     |
| Mingo Co.            | 37,950          | 24,142          | -13,808                 | -36                       | 11.4                                   | 18.6                                   | 11.3  | 63                         | 0                                     |
| Monongalia Co.       | 76,567          | 105,782         | 29,215                  | 38                        | 13.4                                   | 40.2                                   | 41.9  | 200                        | 29                                    |
| Monroe Co.           | 12,800          | 13,382          | 582                     | 5                         | 6.3                                    | 13.1                                   | 10.6  | 108                        | 6                                     |
| Morgan Co.           | 10,989          | 17,716          | 6,727                   | 61                        | 10.4                                   | 22.7                                   | 19.2  | 118                        | 61                                    |
| Nicholas Co.         | 28,675          | 25,125          | -3,550                  | -12                       | 12.3                                   | 25.0                                   | 19.8  | 103                        | 0                                     |
| Ohio Co.             | 60,094          | 42,001          | -18,093                 | -30                       | 12.3                                   | 17.0                                   | 7.3   | 38                         | 0                                     |

| West Virginia County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Pendleton Co.        | 7,959           | 6,973           | -986                    | -12                       | 6.1                                    | 11.3                                   | 8.1   | 85                         | 0                                     |
| Pleasants Co.        | 8,088           | 7,455           | -633                    | -8                        | 5.7                                    | 7.7                                    | 3.1   | 35                         | 0                                     |
| Pocahontas Co.       | 9,618           | 8,493           | -1,125                  | -12                       | 7.2                                    | 12.7                                   | 8.6   | 76                         | 0                                     |
| Preston Co.          | 30,781          | 33,826          | 3,045                   | 10                        | 19.3                                   | 36.6                                   | 27.0  | 90                         | 15                                    |
| Putnam Co.           | 38,938          | 56,692          | 17,754                  | 46                        | 19.2                                   | 37.8                                   | 29.1  | 97                         | 55                                    |
| Raleigh Co.          | 87,159          | 75,066          | -12,093                 | -14                       | 19.5                                   | 38.9                                   | 30.3  | 99                         | 0                                     |
| Randolph Co.         | 29,303          | 28,894          | -409                    | -1                        | 17.3                                   | 24.5                                   | 11.3  | 42                         | 0                                     |
| Ritchie Co.          | 11,410          | 9,851           | -1,559                  | -14                       | 6.2                                    | 14.7                                   | 13.3  | 137                        | 0                                     |
| Roane Co.            | 16,308          | 14,004          | -2,304                  | -14                       | 8.0                                    | 15.4                                   | 11.6  | 93                         | 0                                     |
| Summers Co.          | 15,810          | 12,882          | -2,928                  | -19                       | 9.1                                    | 12.2                                   | 4.8   | 34                         | 0                                     |
| Taylor Co.           | 16,685          | 16,914          | 229                     | 1                         | 5.9                                    | 10.4                                   | 7.0   | 76                         | 2                                     |
| Tucker Co.           | 8,504           | 6,992           | -1,512                  | -18                       | 7.7                                    | 12.1                                   | 6.9   | 57                         | 0                                     |

| West Virginia County    | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Tyler Co.               | 11,368           | 8,800            | -2,568                  | -23                       | 3.8                                    | 7.0                                    | 5.0   | 84                         | 0                                     |
| Upshur Co.              | 24,284           | 24,555           | 271                     | 1                         | 6.4                                    | 16.9                                   | 16.4  | 164                        | 0                                     |
| Wayne Co.               | 46,008           | 40,215           | -5,793                  | -13                       | 9.0                                    | 18.8                                   | 15.3  | 109                        | 0                                     |
| Webster Co.             | 11,932           | 8,348            | -3,584                  | -30                       | 3.1                                    | 4.0                                    | 1.4   | 29                         | 0                                     |
| Wetzel Co.              | 21,569           | 15,433           | -6,136                  | -28                       | 5.3                                    | 6.5                                    | 1.9   | 23                         | 0                                     |
| Wirt Co.                | 5,071            | 5,786            | 715                     | 14                        | 1.9                                    | 3.9                                    | 3.1   | 105                        | 18                                    |
| Wood Co.                | 92,429           | 85,060           | -7,369                  | -8                        | 21.3                                   | 44.1                                   | 35.6  | 107                        | 0                                     |
| Wyoming Co.             | 35,136           | 21,271           | -13,865                 | -39                       | 9.9                                    | 15.8                                   | 9.2   | 60                         | 0                                     |
| <b>Totals</b>           | <b>1,949,605</b> | <b>1,817,004</b> | <b>-132,601</b>         | <b>-7</b>                 | <b>638.1</b>                           | <b>1,167.6</b>                         | <b>827.3</b>                                      | <b>83</b>                  | <b>0</b>                              |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>18</b>                             |



**Scatter Plot for West Virginia County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.93**

**Wisconsin**

| <b>Wisconsin County</b> | <b>1982 Population</b> | <b>2017 Population</b> | <b>Pop Change 1982 to 2017</b> | <b>% Pop Change 1982 to 2017</b> | <b>Developed Land 1982 (1,000's of acres)</b> | <b>Developed Land 2017 (1,000's of acres)</b> | <b>Change in Developed Land (Sprawl in square miles)</b> | <b>% Change In Developed Land</b> | <b>% Sprawl Related to Population Growth</b> |
|-------------------------|------------------------|------------------------|--------------------------------|----------------------------------|---|---|--|-----------------------------------|--|
| Adams Co.               | 14,320                 | 19,900                 | 5,580                          | 39                               | 30.0  | 43.3  | 20.8   | 44                                | 90   |
| Ashland Co.             | 17,365                 | 15,501                 | -1,864                         | -11                              | 17.1  | 19.6  | 3.9  | 15                                | 0  |
| Barron Co.              | 39,761                 | 45,141                 | 5,380                          | 14                               | 24.1  | 35.5  | 17.8   | 47                                | 33   |
| Bayfield Co.            | 14,220                 | 15,006                 | 786                            | 6                                | 14.0  | 15.2  | 1.9  | 9                                 | 65   |
| Brown Co.               | 178,340                | 261,762                | 83,422                         | 47                               | 61.6  | 96.4  | 54.4   | 56                                | 86   |
| Buffalo Co.             | 14,355                 | 13,105                 | -1,250                         | -9                               | 11.0  | 15.0  | 6.3  | 36                                | 0  |
| Burnett Co.             | 12,771                 | 15,295                 | 2,524                          | 20                               | 21.3  | 26.1  | 7.5  | 23                                | 89   |
| Calumet Co.             | 31,325                 | 49,995                 | 18,670                         | 60                               | 14.2  | 21.6  | 11.6   | 52                                | 100  |
| Chippewa Co.            | 53,105                 | 63,747                 | 10,642                         | 20                               | 40.5  | 55.4  | 23.3   | 37                                | 58   |
| Clark Co.               | 32,957                 | 34,571                 | 1,614                          | 5                                | 21.9  | 27.3  | 8.4  | 25                                | 22   |
| Columbia Co.            | 43,449                 | 57,244                 | 13,795                         | 32                               | 22.3  | 35.3  | 20.3   | 58                                | 60   |

| Wisconsin County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Crawford Co.     | 16,704          | 16,199          | -505                    | -3                        | 9.0                                    | 11.6                                   | 4.1   | 29                         | 0                                     |
| Dane Co.         | 329,188         | 537,453         | 208,265                 | 63                        | 78.9                                   | 116.4                                  | 58.6  | 48                         | 100                                   |
| Dodge Co.        | 74,908          | 87,705          | 12,797                  | 17                        | 43.0                                   | 56.1                                   | 20.5  | 30                         | 59                                    |
| Door Co.         | 25,652          | 27,454          | 1,802                   | 7                         | 40.2                                   | 52.2                                   | 18.8  | 30                         | 26                                    |
| Douglas Co.      | 44,801          | 43,328          | -1,473                  | -3                        | 34.7                                   | 48.6                                   | 21.7  | 40                         | 0                                     |
| Dunn Co.         | 34,934          | 44,714          | 9,780                   | 28                        | 16.3                                   | 28.5                                   | 19.1  | 75                         | 44                                    |
| Eau Claire Co.   | 80,633          | 103,582         | 22,949                  | 28                        | 25.9                                   | 40.5                                   | 22.8  | 56                         | 56                                    |
| Florence Co.     | 4,211           | 4,335           | 124                     | 3                         | 5.2                                    | 6.4                                    | 1.9   | 23                         | 14                                    |
| Fond du Lac Co.  | 88,361          | 102,417         | 14,056                  | 16                        | 37.6                                   | 52.3                                   | 23.0  | 39                         | 45                                    |
| Forest Co.       | 9,203           | 8,969           | -234                    | -3                        | 10.0                                   | 14.3                                   | 6.7   | 43                         | 0                                     |
| Grant Co.        | 51,663          | 51,728          | 65                      | 0                         | 26.1                                   | 33.3                                   | 11.3  | 28                         | 1                                     |
| Green Co.        | 30,017          | 36,877          | 6,860                   | 23                        | 13.3                                   | 21.1                                   | 12.2  | 59                         | 45                                    |

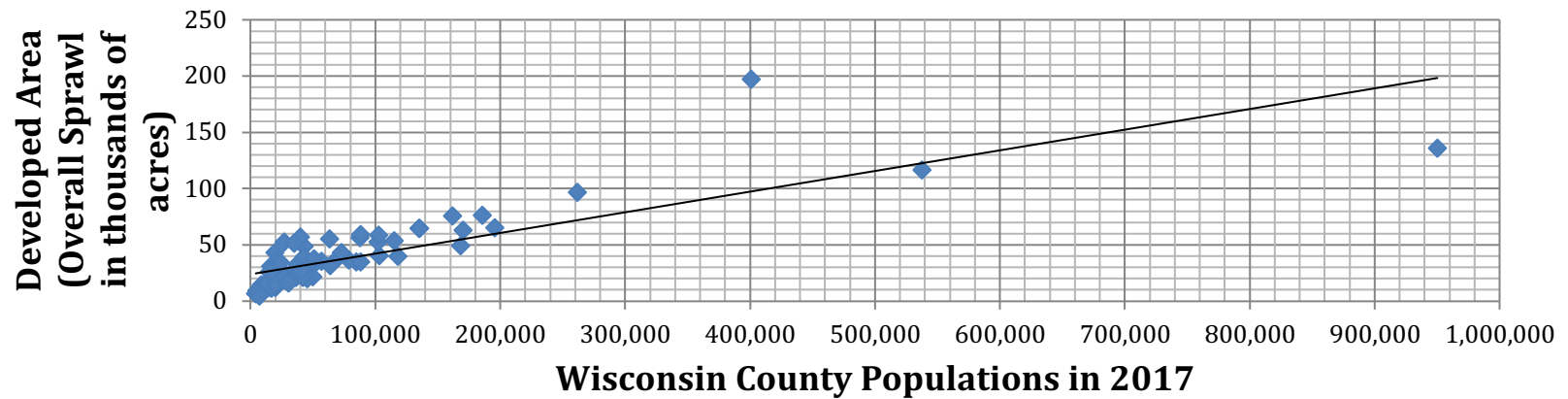
| Wisconsin County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Green Lake Co.   | 18,820          | 18,720          | -100                    | -1                        | 13.4                                   | 18.1                                   | 7.3   | 35                         | 0                                     |
| Iowa Co.         | 20,072          | 23,676          | 3,604                   | 18                        | 15.7                                   | 20.2                                   | 7.0   | 29                         | 66                                    |
| Iron Co.         | 6,681           | 5,675           | -1,006                  | -15                       | 8.9                                    | 9.2                                    | 0.5   | 3                          | 0                                     |
| Jackson Co.      | 17,048          | 20,485          | 3,437                   | 20                        | 14.8                                   | 21.3                                   | 10.2  | 44                         | 50                                    |
| Jefferson Co.    | 66,486          | 84,733          | 18,247                  | 27                        | 25.2                                   | 34.6                                   | 14.7  | 37                         | 77                                    |
| Juneau Co.       | 21,212          | 26,460          | 5,248                   | 25                        | 18.0                                   | 25.5                                   | 11.7  | 42                         | 63                                    |
| Kenosha Co.      | 121,382         | 168,356         | 46,974                  | 39                        | 26.0                                   | 49.4                                   | 36.6  | 90                         | 51                                    |
| Kewaunee Co.     | 19,952          | 20,401          | 449                     | 2                         | 9.3                                    | 12.3                                   | 4.7   | 32                         | 8                                     |
| La Crosse Co.    | 92,617          | 118,033         | 25,416                  | 27                        | 28.5                                   | 39.6                                   | 17.3  | 39                         | 74                                    |
| Lafayette Co.    | 17,468          | 16,689          | -779                    | -4                        | 11.0                                   | 14.7                                   | 5.8   | 34                         | 0                                     |
| Langlade Co.     | 20,146          | 19,175          | -971                    | -5                        | 16.9                                   | 19.0                                   | 3.3   | 12                         | 0                                     |
| Lincoln Co.      | 26,632          | 27,751          | 1,119                   | 4                         | 16.9                                   | 21.6                                   | 7.3   | 28                         | 17                                    |

| Wisconsin County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Manitowoc Co.    | 82,613          | 79,099          | -3,514                  | -4                        | 28.7                                   | 36.3                                   | 11.9  | 26                         | 0                                     |
| Marathon Co.     | 111,023         | 135,452         | 24,429                  | 22                        | 46.6                                   | 64.6                                   | 28.1  | 39                         | 61                                    |
| Marinette Co.    | 40,197          | 40,300          | 103                     | 0                         | 46.6                                   | 57.0                                   | 16.3  | 22                         | 1                                     |
| Marquette Co.    | 11,992          | 15,280          | 3,288                   | 27                        | 13.6                                   | 18.6                                   | 7.8   | 37                         | 77                                    |
| Menominee Co.    | 3,379           | 4,599           | 1,220                   | 36                        | 5.0                                    | 6.9                                    | 3.0   | 38                         | 96                                    |
| Milwaukee Co.    | 960,664         | 950,172         | -10,492                 | -1                        | 124.0                                  | 135.9                                  | 18.6  | 10                         | 0                                     |
| Monroe Co.       | 35,635          | 45,715          | 10,080                  | 28                        | 15.5                                   | 19.7                                   | 6.6   | 27                         | 100                                   |
| Oconto Co.       | 28,979          | 37,531          | 8,552                   | 30                        | 22.0                                   | 32.4                                   | 16.3  | 47                         | 67                                    |
| Oneida Co.       | 31,589          | 35,236          | 3,647                   | 12                        | 37.0                                   | 51.6                                   | 22.8  | 39                         | 33                                    |
| Outagamie Co.    | 130,129         | 185,816         | 55,687                  | 43                        | 40.1                                   | 76.2                                   | 56.4  | 90                         | 55                                    |
| Ozaukee Co.      | 67,128          | 88,443          | 21,315                  | 32                        | 24.1                                   | 34.9                                   | 16.9  | 45                         | 74                                    |
| Pepin Co.        | 7,432           | 7,246           | -186                    | -3                        | 3.5                                    | 4.4                                    | 1.4   | 26                         | 0                                     |

| Wisconsin County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Pierce Co.       | 32,409          | 42,016          | 9,607                   | 30                        | 14.1                                   | 21.0                                   | 10.8  | 49                         | 65                                    |
| Polk Co.         | 33,610          | 43,397          | 9,787                   | 29                        | 30.1                                   | 39.3                                   | 14.4  | 31                         | 96                                    |
| Portage Co.      | 57,957          | 70,565          | 12,608                  | 22                        | 24.3                                   | 38.5                                   | 22.2  | 58                         | 43                                    |
| Price Co.        | 15,991          | 13,380          | -2,611                  | -16                       | 13.0                                   | 14.8                                   | 2.8   | 14                         | 0                                     |
| Racine Co.       | 171,080         | 195,825         | 24,745                  | 14                        | 45.7                                   | 65.0                                   | 30.2  | 42                         | 38                                    |
| Richland Co.     | 17,879          | 17,517          | -362                    | -2                        | 9.6                                    | 11.4                                   | 2.8   | 19                         | 0                                     |
| Rock Co.         | 137,893         | 162,205         | 24,312                  | 18                        | 55.6                                   | 75.8                                   | 31.6  | 36                         | 52                                    |
| Rusk Co.         | 15,581          | 14,148          | -1,433                  | -9                        | 10.9                                   | 16.3                                   | 8.4   | 50                         | 0                                     |
| St. Croix Co.    | 44,622          | 88,560          | 43,938                  | 98                        | 23.0                                   | 59.0                                   | 56.3  | 157                        | 73                                    |
| Sauk Co.         | 44,527          | 63,967          | 19,440                  | 44                        | 24.0                                   | 31.6                                   | 11.9  | 32                         | 100                                   |
| Sawyer Co.       | 13,686          | 16,367          | 2,681                   | 20                        | 22.0                                   | 30.9                                   | 13.9  | 40                         | 53                                    |
| Shawano Co.      | 36,547          | 40,846          | 4,299                   | 12                        | 21.2                                   | 27.3                                   | 9.5   | 29                         | 44                                    |

| Wisconsin County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Sheboygan Co.    | 100,770         | 115,089         | 14,319                  | 14                        | 37.0                                   | 53.5                                   | 25.8  | 45                         | 36                                    |
| Taylor Co.       | 19,323          | 20,314          | 991                     | 5                         | 12.5                                   | 15.1                                   | 4.1   | 21                         | 26                                    |
| Trempealeau Co.  | 26,228          | 29,372          | 3,144                   | 12                        | 14.0                                   | 17.5                                   | 5.5   | 25                         | 51                                    |
| Vernon Co.       | 25,970          | 30,702          | 4,732                   | 18                        | 11.7                                   | 16.0                                   | 6.7   | 37                         | 53                                    |
| Vilas Co.        | 17,000          | 21,684          | 4,684                   | 28                        | 27.0                                   | 36.6                                   | 15.0  | 36                         | 80                                    |
| Walworth Co.     | 72,014          | 102,850         | 30,836                  | 43                        | 34.0                                   | 58.4                                   | 38.1  | 72                         | 66                                    |
| Washburn Co.     | 13,405          | 15,739          | 2,334                   | 17                        | 19.2                                   | 25.8                                   | 10.3  | 34                         | 54                                    |
| Washington Co.   | 84,659          | 134,930         | 50,271                  | 59                        | 30.4                                   | 64.6                                   | 53.4  | 113                        | 62                                    |
| Waukesha Co.     | 279,177         | 400,899         | 121,722                 | 44                        | 135.1                                  | 197.0                                  | 96.7  | 46                         | 96                                    |
| Waupaca Co.      | 43,834          | 51,118          | 7,284                   | 17                        | 28.2                                   | 37.8                                   | 15.0  | 34                         | 52                                    |
| Waushara Co.     | 18,443          | 24,193          | 5,750                   | 31                        | 28.6                                   | 34.5                                   | 9.2   | 21                         | 100                                   |
| Winnebago Co.    | 131,330         | 170,394         | 39,064                  | 30                        | 46.1                                   | 63.2                                   | 26.7  | 37                         | 83                                    |

| Wisconsin County        | 1982 Population  | 2017 Population  | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|------------------|------------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Wood Co.                | 73,408           | 73,038           | -370                    | -1                        | 36.3                                   | 43.3                                   | 10.9  | 19                         | 0                                     |
| <b>Totals</b>           | <b>4,728,862</b> | <b>5,790,186</b> | <b>1,061,324</b>        | <b>22</b>                 | <b>1,983.1</b>                         | <b>2,790.2</b>                         | <b>1,261.1</b>                                    | <b>41</b>                  | <b>59</b>                             |
| <b>Weighted Average</b> |                  |                  |                         |                           |  |  |   |                            | <b>58</b>                             |



**Scatter Plot for Wisconsin County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

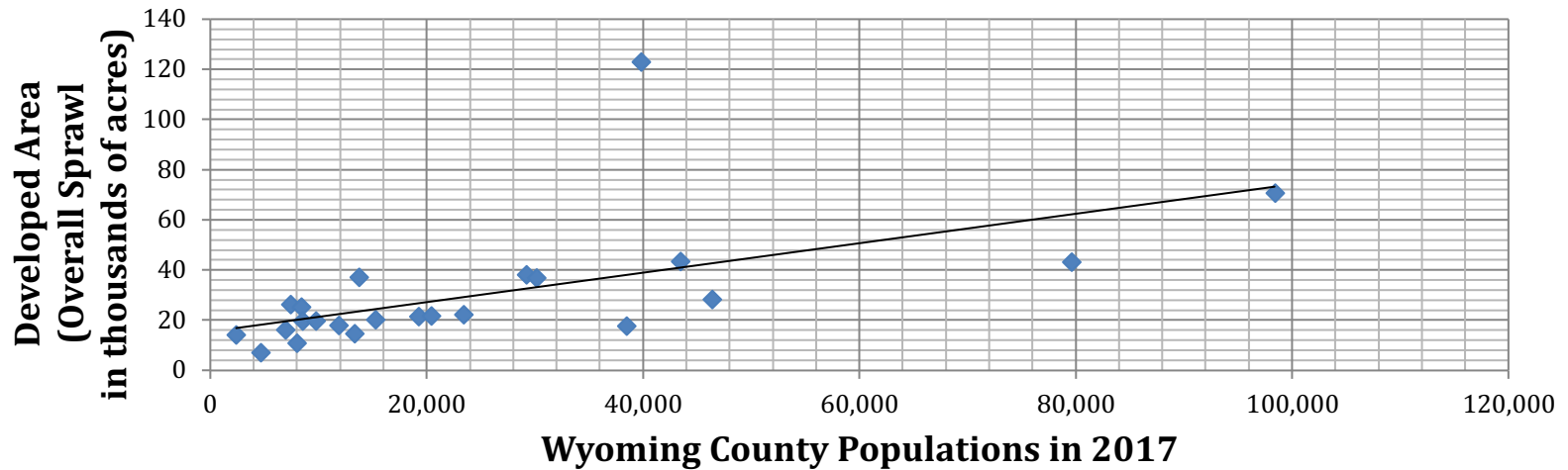
**R-value: 0.80**

**Wyoming**

| Wyoming County  | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Albany Co.      | 30,608          | 38,459          | 7,851                   | 26                        | 13.6                                   | 17.7                                   | 6.4   | 30                         | 87                                    |
| Big Horn Co.    | 12,791          | 11,859          | -932                    | -7                        | 14.1                                   | 18.0                                   | 6.1   | 28                         | 0                                     |
| Campbell Co.    | 31,559          | 46,402          | 14,843                  | 47                        | 26.4                                   | 28.4                                   | 3.1   | 8                          | 100                                   |
| Carbon Co.      | 22,374          | 15,252          | -7,122                  | -32                       | 18.1                                   | 20.2                                   | 3.3   | 12                         | 0                                     |
| Converse Co.    | 15,036          | 13,733          | -1,303                  | -9                        | 32.4                                   | 37.2                                   | 7.5   | 15                         | 0                                     |
| Crook Co.       | 5,620           | 7,397           | 1,777                   | 32                        | 21.1                                   | 26.3                                   | 8.1   | 25                         | 100                                   |
| Fremont Co.     | 38,492          | 39,818          | 1,326                   | 3                         | 113.4                                  | 123.0                                  | 15.0  | 8                          | 42                                    |
| Goshen Co.      | 12,412          | 13,361          | 949                     | 8                         | 12.4                                   | 14.7                                   | 3.6   | 19                         | 43                                    |
| Hot Springs Co. | 5,982           | 4,686           | -1,296                  | -22                       | 4.8                                    | 7.0                                    | 3.4   | 46                         | 0                                     |
| Johnson Co.     | 7,128           | 8,447           | 1,319                   | 19                        | 23.4                                   | 25.3                                   | 3.0   | 8                          | 100                                   |
| Laramie Co.     | 71,129          | 98,377          | 27,248                  | 38                        | 48.9                                   | 70.8                                   | 34.2  | 45                         | 88                                    |

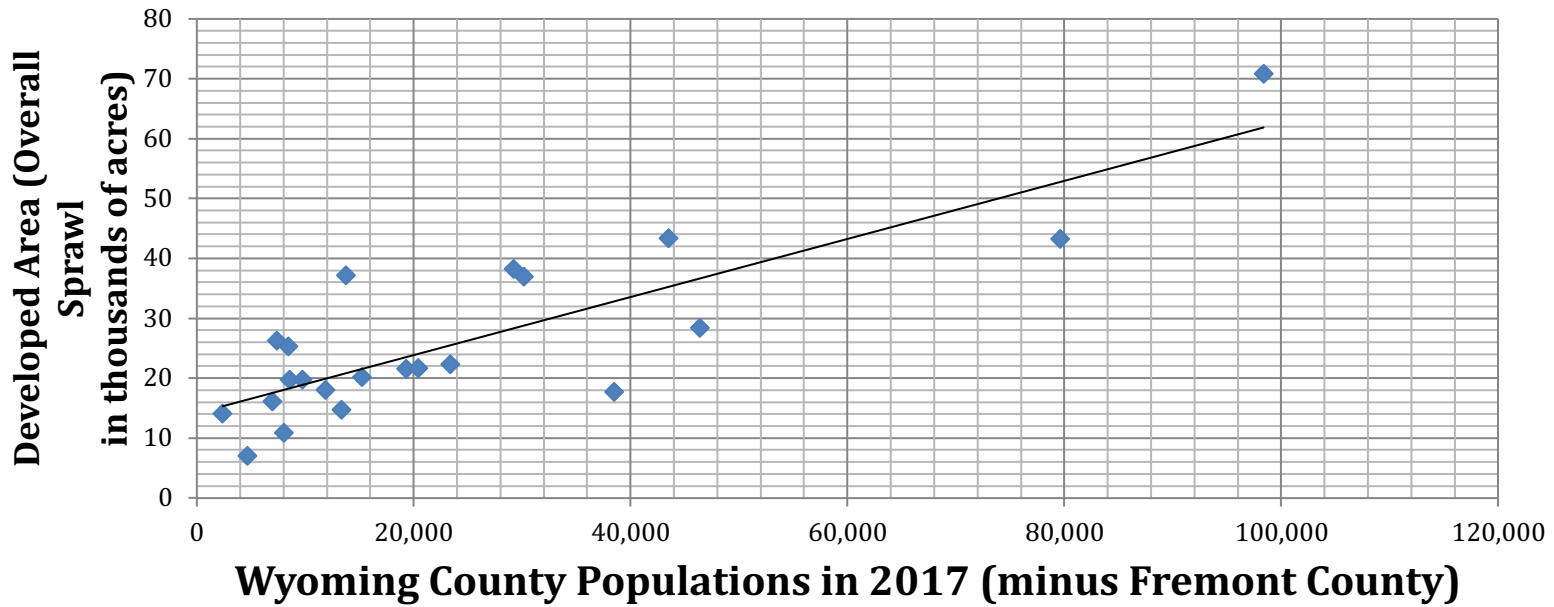
| Wyoming County | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|----------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| Lincoln Co.    | 14,030          | 19,278          | 5,248                   | 37                        | 10.9                                   | 21.6                                   | 16.7  | 98                         | 46                                    |
| Natrona Co.    | 77,094          | 79,586          | 2,492                   | 3                         | 35.4                                   | 43.2                                   | 12.2  | 22                         | 16                                    |
| Niobrara Co.   | 3,109           | 2,392           | -717                    | -23                       | 10.6                                   | 14.1                                   | 5.5   | 33                         | 0                                     |
| Park Co.       | 23,263          | 29,194          | 5,931                   | 25                        | 25.0                                   | 38.2                                   | 20.6  | 53                         | 54                                    |
| Platte Co.     | 10,337          | 8,541           | -1,796                  | -17                       | 15.9                                   | 19.7                                   | 5.9   | 24                         | 0                                     |
| Sheridan Co.   | 26,376          | 30,147          | 3,771                   | 14                        | 26.5                                   | 36.9                                   | 16.3  | 39                         | 40                                    |
| Sublette Co.   | 5,142           | 9,745           | 4,603                   | 90                        | 10.3                                   | 19.7                                   | 14.7  | 91                         | 99                                    |
| Sweetwater Co. | 45,750          | 43,464          | -2,286                  | -5                        | 28.2                                   | 43.4                                   | 23.8  | 54                         | 0                                     |
| Teton Co.      | 10,519          | 23,384          | 12,865                  | 122                       | 7.6                                    | 22.3                                   | 23.0  | 193                        | 74                                    |
| Uinta Co.      | 19,720          | 20,431          | 711                     | 4                         | 16.0                                   | 21.7                                   | 8.9   | 36                         | 12                                    |
| Washakie Co.   | 10,140          | 8,010           | -2,130                  | -21                       | 7.7                                    | 10.9                                   | 5.0   | 42                         | 0                                     |
| Weston Co.     | 7,789           | 6,968           | -821                    | -11                       | 12.9                                   | 16.1                                   | 5.0   | 25                         | 0                                     |

| Wyoming County          | 1982 Population | 2017 Population | Pop Change 1982 to 2017 | % Pop Change 1982 to 2017 | Developed Land 1982 (1,000's of acres) | Developed Land 2017 (1,000's of acres) | Change in Developed Land (Sprawl in square miles) | % Change In Developed Land | % Sprawl Related to Population Growth |
|-------------------------|-----------------|-----------------|-------------------------|---------------------------|--|--|---|----------------------------|---------------------------------------|
| <b>Totals</b>           | <b>506,400</b>  | <b>578,931</b>  | <b>72,531</b>           | <b>14</b>                 | <b>535.6</b>                           | <b>696.4</b>                           | <b>251.3</b>                                      | <b>30</b>                  | <b>51</b>                             |
| <b>Weighted Average</b> |                 |                 |                         |                           |  |  |   |                            | <b>47</b>                             |



**Scatter Plot for Wyoming County Populations versus Developed Land Area (Cumulative Sprawl) in 2017**

**R-value: 0.58**



**Scatter Plot for Wyoming County Populations versus Developed Land Area (Cumulative Sprawl) in 2017 (excluding Fremont County)**

**R-value: 0.83**

## Appendix E

### 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**, *associate 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 (1924-2017)**, *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**, *attorney, 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 F

### 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: 85% Very or somewhat IMPORTANT  
13% NOT VERY or at all important

8\* A study of government data found that most of the development-related 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

## Appendix G

### National Survey of 1,500 Likely Voters

Conducted May 25-27, 2020 By Pulse Opinion Research

1\* The U.S. Department of Agriculture calculates that in recent decades urban sprawl has destroyed 43 million acres of farmland and natural habitat, an area about equal in size to all of New England. If this trend were to continue, would it be a major problem, somewhat of a problem, not much of a problem, or not a problem at all?

**44%** A major problem

**35%** Somewhat of a problem

**11%** Not much of a problem

**4%** Not a problem at all

**6%** Not sure

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?

**62%** Very important

**27%** Somewhat important

**6%** Not very important

**1%** Not important at all

**3%** Not sure

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?

**32%** Very important

**45%** Somewhat important

**16%** Not very important

**4%** Not important at all

**3%** Not sure

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?

**62%** It is unethical to pave over and build on good cropland

**18%** The need for more housing is a legitimate reason to eliminate cropland

**20%** Not sure

5\* The government reports that to make room for growing cities the last three decades, 19 million acres of surrounding woodlands have been cut down. How significant a problem is this loss of natural wildlife habitat?

**51%** Very significant

**34%** Somewhat significant

**9%** Not very significant

**2%** Not significant at all

**4%** Not sure

6\* Does the United States have a responsibility to the rest of the world to preserve a certain amount of its natural habitat or is preserving the United States natural habitat not a matter of global concern?

**62%** The United States has a responsibility to the rest of world to preserve its natural habitat

**27%** Preserving the natural habitat is not a matter of global concern

**11%** Not sure

7\* Do you feel an emotional or spiritual uplift from time spent in natural areas like woodlands, wetlands and grasslands?

**73%** Yes

**16%** No

**11%** Not sure

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

- 45% Very important
- 40% Somewhat important
- 10% Not very important
- 2% Not important at all
- 3% Not sure

9\* A study of government data found that most of the development destruction of farmland and natural habitat in the last decade has been related to the country's population growing by 22 million people. The Census Bureau projects the population is on pace to add another 86 million in the next 40 years. Would this rate of population growth in YOUR area make it a better place to live, a worse place to live, or would it not make much difference?

- 16% A better place to live
- 50% A worse place to live
- 25% Not make much difference
- 9% Not sure

10\* If the population in YOUR AREA were to increase significantly, would the government be able to build enough extra transportation capacity to accommodate the extra people or would traffic likely become much worse?

- 28% The government would be able to build enough extra transportation capacity to accommodate the extra people
- 61% Traffic likely would become much worse
- 12% Not sure

11\* Over the rest of this century, would you prefer that the nation's population continue to grow toward 500 million, grow much more slowly, stay about the same as it is now at 331 million, or slowly become smaller?

**17%** Continue to grow toward 500 million

**43%** Grow much more slowly

**22%** Stay about the same at 331 million

**10%** Slowly become smaller

**8%** Not sure

12\* Census data shows that since 1970, annual immigration has tripled and is now the cause of nearly all long-term population growth. Should the federal government reduce annual immigration to slow down population growth, keep immigration and population growth at the current level, or increase annual immigration and population growth?

**47%** Reduce annual immigration to slow down population growth

**33%** Keep annual immigration and population growth at the current level

**12%** Increase annual immigration and population growth

**8%** Not sure

13\* Currently the government allows one million legal immigrants each year. How many legal immigrants should the government allow each year -- two million or more, one million, a half-million, or 100,000 or less?

**17%** Two million or more

**27%** One million

**21%** Half a million

**22%** 100,000 or less

**14%** Not sure

14\* One way to handle continued population growth without losing as much natural habitat and farmland would be to increase population density by changing zoning and other regulations so more residents live in apartments and condo buildings instead of single-family houses. Do you strongly favor, somewhat favor, somewhat oppose or strongly oppose this kind of change?

- 16% Strongly favor
- 32% Somewhat favor
- 24% Somewhat oppose
- 17% Strongly oppose
- 12% Not sure

15\* Which best describes your current neighborhood -- is it higher population-density with at least some apartments or townhouses, is it less-densely populated with mostly single-family houses, or is it rural?

- 32% Your neighborhood is higher population-density with at least some apartments or townhouses
- 50% Less-densely populated with mostly single-family houses
- 14% If rural
- 3% Not sure

16\* Would you prefer to live in a mixed higher-density neighborhood of stores, townhouses, apartments and condos, a neighborhood of single-family houses, or a rural area?

- 26% Mixed higher-density neighborhood of stores, townhouses, apartments and condos
- 45% Neighborhood of single-family houses
- 24% Rural area
- 5% Not sure

17\* As a result of the coronavirus pandemic, does living in a more densely populated area appear more attractive, less attractive or has it not made much difference?

- 14% More attractive
- 50% Less attractive
- 32% It has not made much difference
- 3% Not sure

**NOTE:** Margin of Sampling Error, +/- 2.5 percentage points with a 95% level of confidence

## Appendix H

### Major Findings of our First National Sprawl Studies in 2001 and 2003

Our first two national sprawl studies – conducted two decades 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”<sup>126</sup> and “Outsmarting Smart Growth: Population Growth, Immigration, and the Problem of Sprawl.”<sup>127</sup> 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 H-1**).
- (2) Population Growth:** The other half of sprawl is related to the increase in the number of residents within those 100 Urbanized Areas.

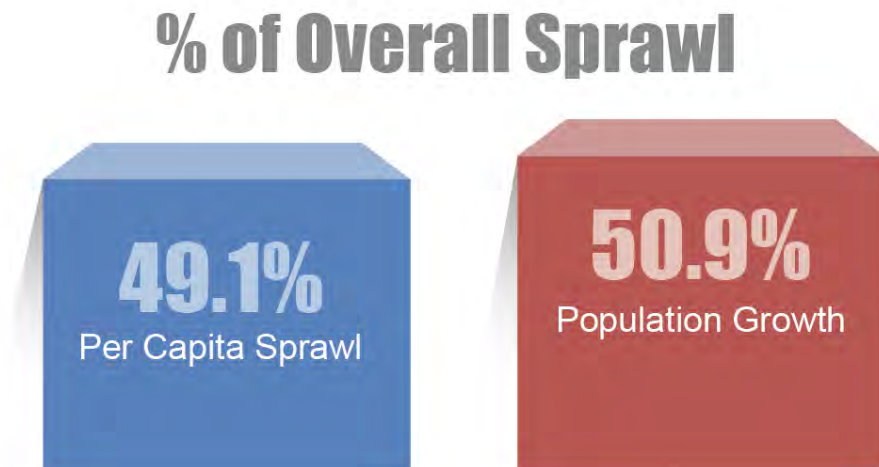
“On average, there are more of us, and each of us is using more urban land, and therein lie the two halves of the problem,” wrote the authors in the 2001 study. These findings then led the authors to the following conclusions:

- 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.

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<sup>126</sup> 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>.

<sup>127</sup> 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>.



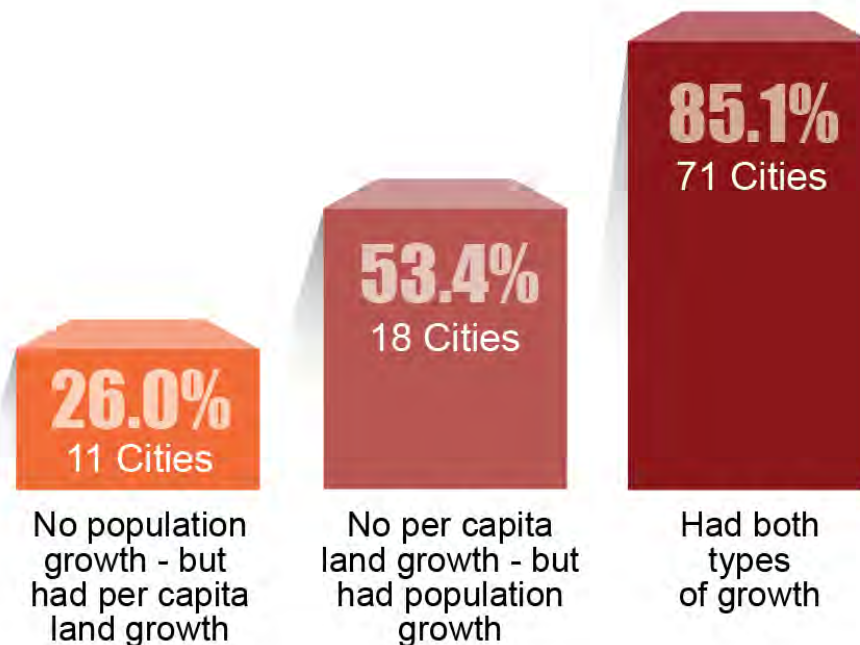
**Figure H-1. Sources of Urban Sprawl in 100 Largest Cities, 1970-1990**

*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 H-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:

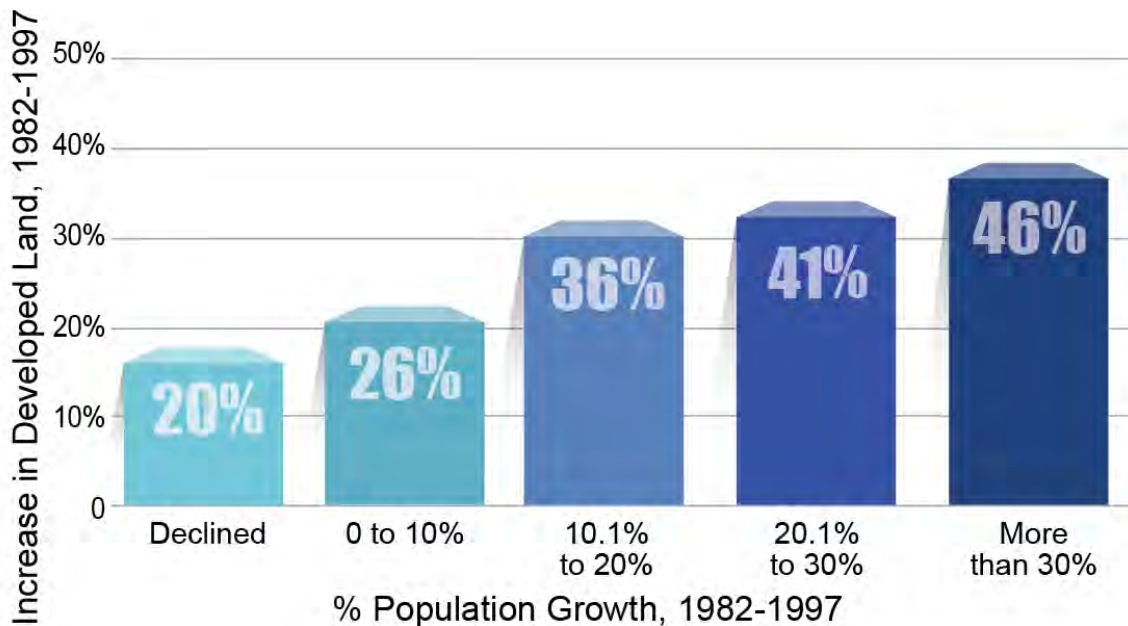


**Figure H-2. Average Sprawl Rate by Type of Growth, 100 Largest Cities, 1970-1990**

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

- The more a given state's population grew, the more the state sprawled (see **Figure H-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 H-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.



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