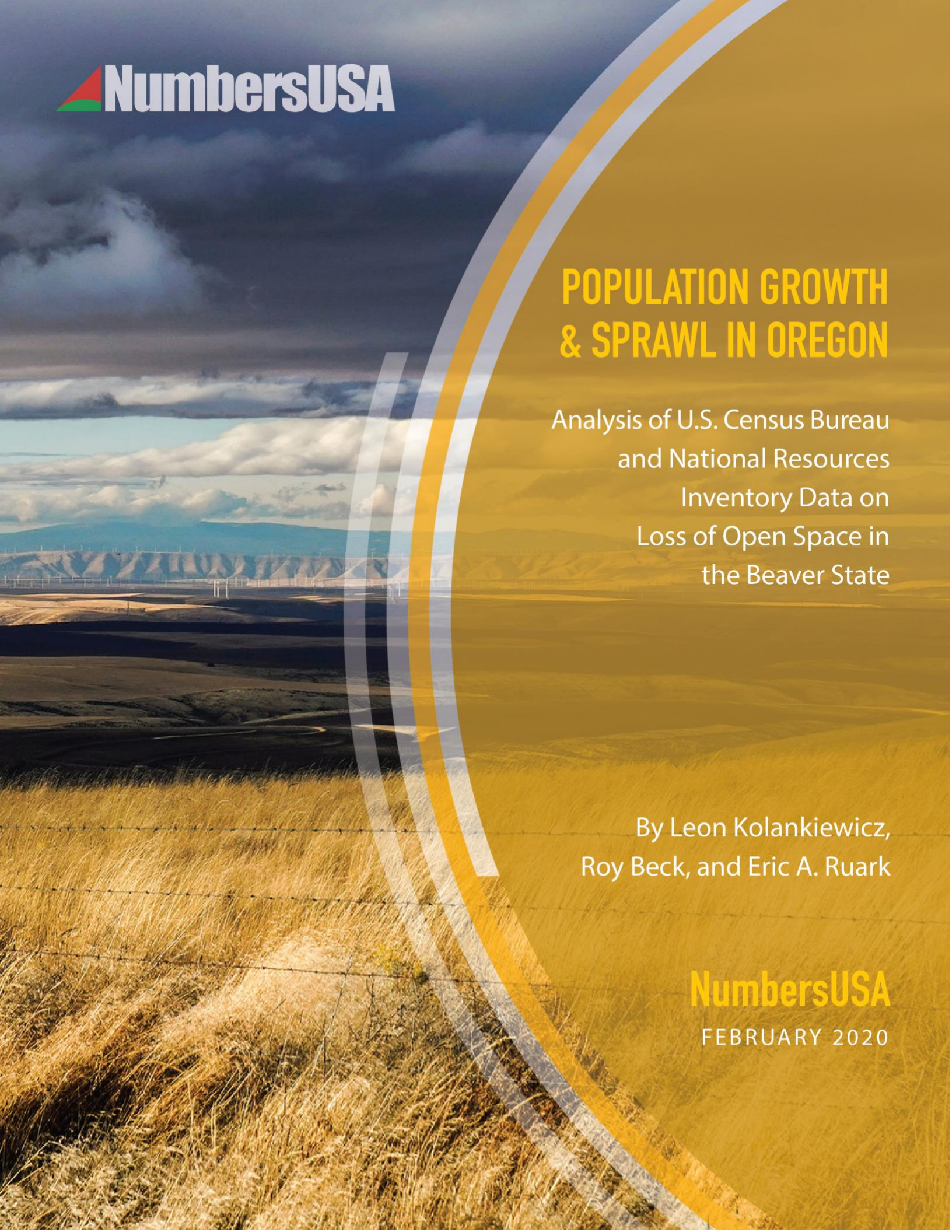

NumbersUSA

POPULATION GROWTH & SPRAWL IN OREGON

Analysis of U.S. Census Bureau and National Resources Inventory Data on Loss of Open Space in the Beaver State

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

NumbersUSA
FEBRUARY 2020

Analysis of Data from the U.S. Census Bureau and National Resources Inventory of the U.S. Department of Agriculture, Natural Resources Conservation Service on Loss of Open Space to Urban Sprawl in Oregon

About the Authors

LEON KOLANKIEWICZ is a national environmental/natural resources planner and a former planner with the Orange County (California) Environmental Management Agency. He has a B.S. in forestry and wildlife management from Virginia Tech and an M.S. in environmental planning from the University of British Columbia. He has worked as an environmental professional for more than three decades in three countries and more than 40 states, including stints with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Alaska Department of Environmental Conservation, Alaska Department of Fish and Game, University of Washington, University of New Mexico, and as a Peace Corps Volunteer promoting natural resources conservation in Honduras. He has written or edited more than 400 articles, blog posts, reports, conservation plans, and environmental impact statements, and is the author of *Where Salmon Come to Die: An Autumn on Alaska's Raincoast* (Pruett, 1993) and a contributor to *Life on the Brink: Environmentalists Confront Overpopulation* (University of Georgia Press, 2012) and *Environment and Society: A Reader* (New York University Press, 2017). He has been the lead author of ten studies on sprawl for NumbersUSA in the past two decades.

ROY BECK was one of the nation's first environment-beat newspaper reporters in the 1960s. A graduate of the University of Missouri School of Journalism, he won national awards for his coverage of urban expansion issues, including honors from the U.S. Environmental Protection Agency and the Izaak Walton League. A former Washington correspondent for Newhouse Newspapers, he is the author of four public policy books. His articles have appeared in scores of magazines, newspapers and journals, including the *Atlantic Monthly, the Journal of Policy History* and the *Encyclopedia Britannica's Annals of America*. He has lectured widely on the ethical aspects of U.S. population issues and testified before Congress on many occasions. He has been co-author of studies on sprawl since 2000. He is President of the NumbersUSA Education & Research Foundation in Arlington, Va., which he founded in 1996 to educate the American public on the recommendations of two federal commissions on sustainability and economic justice.

ERIC A. RUARK is the director of research of NumbersUSA Education & Research Foundation. He attended Virginia Commonwealth University and the University of Maryland, College Park and has a M.S. in modern European history. He has worked as a researcher on U.S. immigration policy since 2008 and has written extensively on the effects of population growth. His work has been cited in national and international media reports and in his testimony in the U.S. Senate.

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Table of Contents

Appendices

List of Tables

List of Figures

POPULATION GROWTH AND SPRAWL IN OREGON

Analysis of U.S. Census Bureau and Natural Resources Inventory Data on Loss of Open Space in the Beaver State

Executive Summary

"DON'T CALIFORNICATE OREGON!" THE BEAVER STATE CONFRONTS RUNAWAY GROWTH AND SPRAWL

Between 1982 and 2015, urban expansion in Oregon eliminated 419,800 acres (656 square miles) of natural habitat and farmland, according to the federal Natural Resources Inventory.

This report examines the role of population growth and consumption in that sprawl. It is the latest in a series of state, regional, and national-level NumbersUSA sprawl studies that began in the year 2000 with California, the state once considered synonymous with urban sprawl in America.

Taking note of California's runaway growth and the threat it posed to his beloved state just to the north, Oregon Governor Tom McCall (1967 to 1975) famously pleaded "Don't Californicate Oregon!" Although it generated a good deal of attention, his plea did not stop millions of Californians disillusioned with their own state from pouring into Oregon – and Washington, Nevada, Arizona, Idaho, Utah, New Mexico, Colorado, and Texas.

For nearly half a century, Oregon's citizen activists and governments have been leaders in the national movement to tame or at least rein in the runaway urban sprawl voraciously consuming the country's open space ever since the post-World War II population and economic booms ignited in the 1950s.

Yet, during that time, hundreds of square miles of sensitive natural habitats, scenic vistas and historic Oregon farmland have fallen victim to developers' and governments' bulldozers.

Some general findings in this study:

- Oregon's efforts in fighting sprawl through **reduction in average land consumption per resident** have been important in reducing the rate of open-space loss in recent years.

- The main factor in largescale open-space destruction is that Oregon has grown from 2,664,922 residents in 1982 to 4,013,845 in 2015, a **population increase of 58 percent**.

- Like existing residents, each of those 1.35 million new residents added during this 33-year period needed built-up land to fulfill a variety of urban functions, including housing, workplaces, transportation, commerce, education and entertainment. On average, **0.311 acre of land** was developed to accommodate each new resident. Thus, for every three new

residents, almost one acre was converted from natural habitat and agricultural land into pavement, manmade structures, and artificial landscaping.

LIMITS OF URBAN GROWTH BOUNDARIES & CITIZEN ANTI-SPRAWL EFFORTS

This report begins with an exploration of the history of Oregon's anti-sprawl efforts **(Sections 1.1-1.2).** Like many resource-rich and beautiful Western states, Oregon has been on the front lines of the struggle over how (and whether) to use, manage, and conserve the land and its treasure troves of natural resources. Should ancient, never-before-logged coniferous forests on the western slopes of the Cascades be harvested to provide jobs for loggers and sawmill workers, as well as important wood products for society, or should they be preserved to safeguard beauty for human appreciation and habitat for imperiled species such as the Northern Spotted Owl and the Marbled Murrelet? Should growing towns and cities be permitted to expand haphazardly across the landscape, devouring farmland, ranchland, range, and wildlife habitats as residential subdivisions and strip malls spread ever outward under the pressure of relentless population growth?

One early and major response was the Oregon state legislature in 1973 passing a landmark statewide comprehensive land use planning law (SB 100). Among other mandates, SB 100 required each existing municipality in the state to establish an urban growth boundary (UGB), beyond which urbanization could not march willy-nilly – at least not without a conscious, informed, publicized decision.

But the goal of UGBs is not (and never was) to stop sprawl permanently at some arbitrary line, but to make the "conversion of land from rural to urban use a conscious and planned decision." Oregon's population has nearly doubled since 1970, and government officials have expanded UGBs to accommodate that population growth, as intended all along.

What has been the effect of the UGB law on at least slowing sprawl in Oregon? One way of investigating this question is to compare the land consumption per capita – or "sprawl per person" – of Oregon's lands developed between 1982 and 2015 with that same measure from other states. This study finds that Oregon ranks a respectable sixth out of the 48 contiguous states, in terms of the newly developed land per person.

But the rate of Overall Sprawl in Oregon has remained high, spurring a number of efforts by citizen groups who recognized that in the face of continuing increases in population and high per capita land consumption, growth management alone would not be able to save the rural lands. The lack of response from Oregon's leaders suggests that they are "hooked on growth," like the leaders in every other municipality and state in the country. The political and economic pressure to accommodate and encourage that growth is overwhelming when the population of the United States is increasing by 20 to 30 million each decade.

Failure to better control that growth has serious implications for Oregon's wildlife, agriculture and human quality of life, as well as for global concerns **(Sections 2.1-2.5).** For example:

- Listed as **threatened or endangered** in the state are 16 mammal species and subspecies, eight birds, four reptiles, one amphibian, 25 fish, and 59 plant species, with habitat loss and fragmentation a major cause.

- Oregon experienced a decline of 16 percent in the area of its **cropland** between 1982 and 2015, compared to 13 percent of cropland decline nationally (in the 48 contiguous states).

- Most open-space loss occurs near where Oregon's residents live and in areas that are the most psychologically or spiritually important to them on a regular basis. Various studies have found **physical and mental health advantages** to these regular interactions with nature and other open spaces, suggesting that nature is not merely "nice" or even a "matter of improving one's mood," but a vital ingredient in healthy human functioning.

- Sprawl in Oregon and Washington is particularly problematic in the midst **of global biodiversity and climate crises**, scientist say. These two states possess virtually all of the forests in the western United States that are considered high priority in importance for global carbon sequestration.

URBAN SPRAWL AS A FUNCTION OF TWO FACTORS

Dozens of diverse factors have been suggested as causes of America's and Oregon's relentless, unending sprawl. They can be reduced to two primary factors.

(1) **Population growth**: Oregon's population growth, like every state's, is determined by the level of foreign immigration, net migration of people from other states, and net births over deaths of residents. Each of these contributes roughly a third of Oregon's growth.

(2) **Increases in per capita land consumption**: This is the combined effect of all factors (other than population change) that raise or lower the urbanized or developed land used per person to provide for housing, transportation, employment, recreation, commerce, education, culture, entertainment, waste handling, utilities, government services and other urban-related functions. Per capita land consumption may increase or decrease in a given urban region due to a variety of factors, including consumer preferences for size and type of housing and yards, governmental subsidies, zoning, energy prices (cheaper fuel encourages sprawl), real and perceived crime rates, quality of schools and other public facilities and services, ethnic and cultural tensions or harmony, job opportunities, and a number of other factors listed in **Section 3.4** of this report.

This study defines sprawl as the amount of rural land lost to development. Sprawl can be measured using two distinct, comprehensive inventories conducted by two unrelated federal agencies with differing methods of measurement:

- The **U.S. Census Bureau** has tabulated changes in the land area size, shape, and population of the nation's Urbanized Areas every 10 years since 1950. This allows calculations for increases in the developed urban footprint for the 10 large Oregon population centers that are classified as Urbanized Areas.

- The **Natural Resources Conservation Service** of the U.S. Department of Agriculture has estimated changes in the amount of America's Developed Lands of all kinds and in all areas since 1982 in its Natural Resources Inventory (NRI). It uses on-the-ground teams and

increasingly sophisticated remote imaging by airplanes and satellites to detect the conversion of rural land into Developed Land, not only around Oregon's 10 Urbanized Areas but around the other 231 towns (larger than 2,500) and the "Small Built-Up Areas" and "Rural Transportation" away from any of the cities. This covers all the state's counties.

Because of different reporting schedules, the most recent period of data for Census Bureau's Urbanized Areas (2000-2010) is different from that for the NRI Developed Land in the counties of the state as a whole (2002-2015). This study also provides information on the entire state for the full period of NRI data (1982-2015).

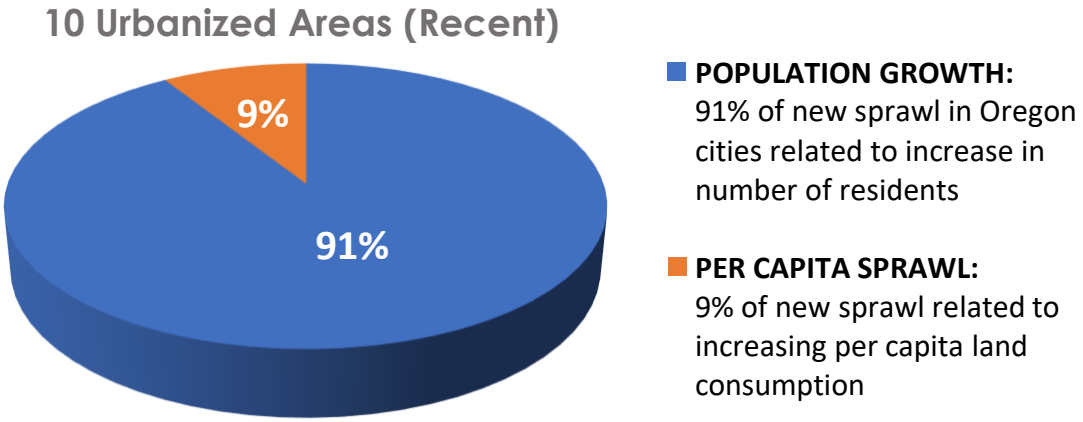

Figure ES-1. Percentages of Sprawl Related to Population Growth and Per Capita Sprawl in Oregon's 10 Urbanized Areas
Data Source: U.S. Census Bureau, 2000-2010

FINDINGS FOR OREGON'S 10 URBANIZED AREAS (2000-2010)

- The aggregate area of urbanized land in the 10 Urbanized Areas (UAs) grew by 97.1 square miles, an increase of 12 percent.
- The population of these same UAs grew by a total of 412,770 residents, or a 17 percent increase.
- On average, per capita land consumption in these 10 UAs decreased by 4%, from 0.22 acre to 0.21 acre per resident over this decade.
- In six out of the 10 Oregon UAs, population growth accounted for virtually 100 percent of the sprawl. In four out of the ten UAs, increasing per capita land consumption (decreasing population density) did account for some percentage of the sprawl (**Table 16** in the main document).

- Taking all of this into account, population growth was found to be related to 91 percent of the sprawl in Oregon's 10 Urbanized Areas from 2000 to 2010 (**Figure ES-1**).

- Population growth in Oregon's UAs was thus responsible for almost ten times as much loss of rural land as Per Capita Sprawl (or rising land consumption per capita): 88.3 square miles vs. 8.8 square miles (**Figure ES-2**).

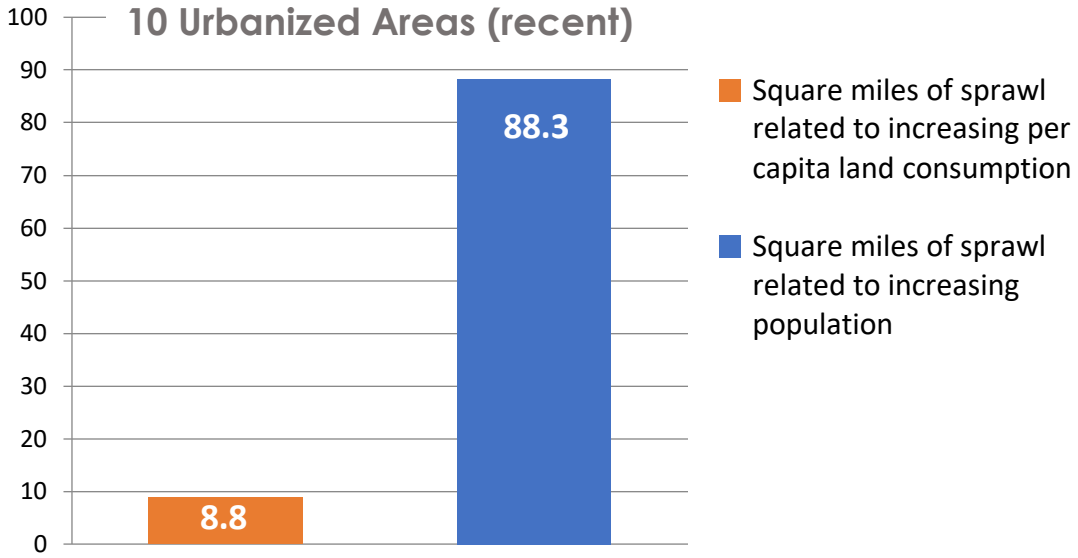

Figure ES-2. Rural Land Lost to Per Capita Sprawl vs. Population Growth in 10 Oregon Urbanized Areas, 2000-2010

FINDINGS FOR ALL OREGON COUNTIES (2002-2015)

Looking at all of Oregon's land area from 2002 to 2015, the analysis of the most recent NRI Developed Land data for all counties found:

- The aggregate area of Developed Land grew by 121 square miles, an increase of six percent.

- The population of the state grew by a total of 511,257 residents, or a 15 percent increase.

- In the state as a whole, per capita land consumption decreased by 8%, from 0.38 acre to 0.35 acre per resident over this 13-year period.

- But per capita sprawl did increase in 14 of 36 counties.

- Population growth was found to be related to 81 percent of state sprawl (**Figure ES-3**).

- Increasing per capita land consumption (declining population density or "low-density sprawl") accounted for 19 percent of Overall Sprawl in Oregon's counties.

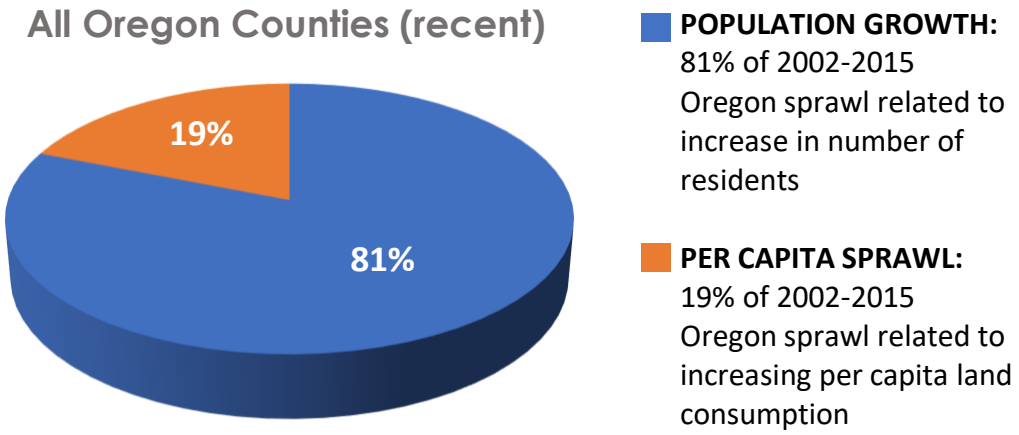

Figure ES-3. Sprawl Factors (Increased Population & Increased Per Capita Land Consumption) in all Oregon Counties, 2002-2015
Data Source: U.S. Census Bureau, 2000-2010

OREGON CITIZEN OPINIONS ON SPRAWL

Pulse Opinion Research conducted a poll for this study on October 28-29, 2019. The results of the survey of 1,000 Oregon voters appear throughout this report. (The entire survey questions, demographics and results appear in **Appendix E**.)

Among the results indicating that most Oregonians are concerned about sprawl and would like to see changes to restrain it:

- 79% said Oregon has developed "too much" or "about as much as it should."
- Only 16% said the additional 656 square miles of new development in Oregon over the last three decades has made the state a "better place to live."
- Informed that the state government projects additional population growth of 1.6 million by 2050, just 30% expressed confidence that state and local governments can keep most of it inside current urban boundaries.
- 81% indicated the government will not be able to add enough extra transportation capacity to prevent traffic from becoming "much worse" while adding 1.6 million residents.
- Only 15% said they are "not very concerned" or "not concerned at all" about "the ability to protect farmland from development."

- 66% said it is "unethical to pave over and build on good farmland" while rejecting that "the demands of a growing population" are a "legitimate reason" to do so.

- 93% said it is very (71%) or somewhat (22%) important to "save the natural areas and open spaces that remain in Oregon.

- 94% said it is very (70%) or somewhat (24%) important to "easily spend time in natural areas near where you live."

- Only 13 percent of Oregon voters indicated they were okay with the present rate of the state's population growth.

POLICY IMPLICATIONS

Our findings couldn't be clearer: persistent population growth accounts for the great majority of sprawl in Oregon. This contradicts the tenacious national myth that the loss of rural lands and open space the last four decades is due primarily to low-density sprawl unrelated to population growth.

That does not discount the necessity for even smarter, more effective, and more efficient urban planning that can reduce per capita land consumption in Oregon. The results of this study suggest that despite Oregon's national leadership in reducing wasteful over-consumption of land, additional efforts to make cities more space-efficient and livable are needed. NRI data indicate that about a fifth of recent Oregon sprawl has continued to be related to growth in per capita land consumption caused by a complicated array of zoning laws, infrastructure subsidies, and complex socioeconomic forces. (These issues and possible solutions are detailed in **Section 5.2**.)

But in pursuing Smart Growth and New Urbanism solutions, Oregon officials have generally neglected the role of population growth, which our study finds related to 81 percent of the sprawl that devoured the natural habitat and farmland of the state in the recent 2002 to 2015 period.

Given the challenge of handling more than half a million new residents during that time, Oregon's officials were clearly unable or unwilling to accommodate both the new residents and existing residents within existing urbanized areas while using only the existing amount of land for public and commercial infrastructure to support the larger population.

Any serious efforts to halt the loss of wildlife habitat and farmland to Oregon sprawl must include reducing the level of population growth in the state.

The public opinion survey of 1,000 Oregon voters found that most are supportive of tackling population growth. More than two-thirds (68%) preferred that Oregon's population "grow much more slowly" or "stop growing." Another 12 percent preferred that the state's population "become smaller." Only 13 percent of Oregon voters said the state's population growth should continue at its recent rate.

Local policy makers truly trying to curb sprawl in Oregon towns and cities have a number of policy actions and instruments to pursue. (These are discussed in greater length in **Section 5.2**.).

Residents and officials of each jurisdiction can start by addressing the question of whether they want their municipality to grow in population size, and if so, by how much and how fast. Any decision that most residents want to at least slow down growth significantly moves the citizens to additional questions, such as what purpose should the population growth serve and then how to encourage only that kind of growth, as well as how to accommodate it within the existing urban footprint.

The concept that residents have any say at all in whether their home communities encourage population growth has not been the prevailing one in Oregon or across the country. It will take a new form of citizen activism and public leadership to take the steps necessary to seriously reduce habitat and farmland destruction in the future.

Much of Oregon's population growth comes from people moving from other states. Citizens and their leaders will have to decide if they are willing to make that more difficult by imposing more restrictions on expanding development, for example.

Challenged with handling more than half a million new residents from 2002 to 2015, Oregon officials were unable or unwilling to accommodate them within existing urbanized areas.

Of course, the people of a municipality can also decide that they *do* prefer the zoning, planning and subsidies that attract more population growth. But this study makes clear that it is nearly impossible for a city to choose that option and at the same time protect the natural habitat and farmland that surround it.

In the coming decades, many people will choose to seek a home in Oregon, as indicated by official demographic projections of the State of Oregon's Office of Economic Analysis in the Department of Administrative Services. Oregon's population is projected to grow from 4.0 million in 2015 to 5.6 million by 2050, approximately double the state's population in 1990. According to these projections, in 2050, Oregon's population would still be increasing by tens of thousands annually and some 300,000 to 400,000 every decade.

Oregon governments can reduce that significantly over the short term through measures that ensure that all new developments pay for themselves and benefit those citizens who already live in the state.

But Oregon residents and officials can hope only to slow population growth in their jurisdictions if national population continues to increase on average by about 2 to 3 million additional residents each year. These 20-30 million additional American residents per decade each have to settle somewhere, in some community or other, inevitably leading to additional sprawl pressures as far and as long as the eye can see.

The cause of this continuing U.S. population boom is not the fertility of native-born Americans, which has not been a cause of long-term population growth since the early 1970s when births to each woman no longer exceeded the 2.1 replacement level.

Nearly all long-term U.S. population growth comes as a result of Congress changing federal immigration policies. Annual admissions since 1990 have been at around a million a year, three to four times higher than in the 1950s and 1960s.

Unless Americans and immigrants decide to move to a one-child-per-woman average (a reduction by almost half of the current average), any serious efforts to reduce Oregon's population growth enough to halt the loss of farmland and wildlife habitat must include lowering the annual level of immigration into the country as a whole. This will be partly in the hands of the people whom anti-sprawl Oregonians send to Congress.

President Clinton's Council on Sustainable Development in 1996 came to the same conclusion about environmental sustainability in general as this study has advanced about sprawl in Oregon. It stated that the United States needs to stabilize its population in order to meet the nation's environmental and quality-of-life goals. And to do that, it called for reducing immigration to a level that would allow the stabilization. At current just below-replacement native fertility rates in the U.S., that would require that annual immigration be returned down toward the quarter-million level in the 1950s and 1960s.

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

It is important to note that the additional sprawl that occurs because of high immigration levels has nothing to do with the *quality* 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 country.

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 greater or lesser effect on sprawl than a net population growth of the same size from U.S.-born residents. We could find no precise method of quantification but concluded that the various factors largely balanced each other.

Oregon's population growth is influenced by immigration in a major way not involving the actual immigrants settling in the state. Because California has experienced so many negative quality-of-life results from its massive population growth, Oregon receives a large number of California "refugees'" fleeing the over-population. When considering that nearly all of California's population growth is due to immigration from other countries, much of the California migration into Oregon must be considered as another result of the quadrupled level of annual federal immigration.

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, directly and indirectly, add around 20 million people to the nation each decade. All of these people

have to settle in some locality. The reality – which can only be partially mitigated but not eliminated by good planning or Smart Growth – is that the new urbanized land that they will occupy is currently productive agricultural land or irreplaceable natural habitats.

The federal data and this study's analysis of it make this conclusion clear: The desire of most Oregonians to protect the natural world and the human quality of life that they love about their state requires a two-prong approach that is far more vigorous than local and state governments have mounted thus far to control per capita land consumption and the state's population growth.

It is important to note that the additional sprawl that occurs because of high immigration levels has nothing to do with the *quality* of immigrants as people or individuals but everything to do with the *quantity* of population growth that occurs because of immigration.

Public opinion polling suggests a reason that citizens have not been applying enough pressure on governments for them to truly combat sprawl. Although most residents tell pollsters they want much slower or no population growth, they remain closely divided in their support for actions that could actually achieve slower population growth. Nor is there overwhelming support for the kinds of restrictions that would encourage and even force smaller per capita land consumption.

The partial disconnect of heavy support for overall anti-sprawl goals in contrast to the divided support for the means to reach those goals suggests a citizenry that is not fully informed about the causes of sprawl and the options for combatting it. For many Oregonians, they will have to make difficult choices if they are to avoid the never-ending disappearance of the state's habitat and farmland which will be the default option if inaction and insufficient action continue in Oregon.

POPULATION GROWTH AND SPRAWL IN OREGON

Analysis of U.S. Census Bureau and Natural Resources Inventory Data on Loss of Open Space in the Beaver State

1. INTRODUCTION: OREGON CONFRONTS RUNAWAY GROWTH AND SPRAWL

Oregon's population in 1982 stood at 2,664,922. By 2015 (the last year of federal sprawl data), it had grown to 4,016,537. Over 1.3 million residents were added to the state's population across this 33-year span of time, an increase of over 50 percent.

Like existing residents, each new resident added during this time period needed built-up land to fulfill a variety of urban functions: housing, transportation (streets, roads, freeways, driveways, parking lots and structures, railroad and light rail tracks, airports), commercial and office buildings, warehouses, factories and manufacturing, utilities (e.g., transmission and distribution line right-of-ways, electrical substations, power plants, water and wastewater treatment plants), educational and government facilities, and last but not least, parks and recreation.

In fact, between 1982 and 2015, an additional 419,800 acres (656 square miles) of open space in Oregon were developed to accommodate the state's population growth. Oregon's population growth rate ranked it 19 highest among the 48 contiguous states. On average, 0.311 acre of land was developed to accommodate each new resident. For every three new residents, almost one acre was converted from open space – both natural habitat and agricultural land – to pavement, manmade structures, and artificial landscaping.

This 0.311-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 forestlands needed to absorb each resident's carbon dioxide (CO_2) 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 state resident (and all human consumers), contribute to each average Oregonian's ecological footprint. This entails a much larger amount of land, 50 times as much in fact, or 15.7 global acres per person, according to the Global Footprint Network.[1]

[1] Global Footprint Network. 2015. State of the States Report. Accessed on 10-28-18 at: https://www.footprintnetwork.org/2015/07/14/states/

In Oregon, the beautiful landscape always beckons, even from the state's largest city: Mt. Hood (11,250 ft.) from downtown Portland, Oregon - *Photo: U.S. Geological Survey*

This report does not address Oregonians' aggregate ecological footprint but focuses instead on the much narrower category of built-up, developed, or urbanized land, because these are the lands that no longer possess the qualities or perform the ecological services of open space, wildlands, wildlife habitat, forestlands, cropland, ranchland and pastureland.

1.1 Limits of Urban Growth Boundaries

For nearly half a century, Oregon has been a leader among states in the national movement to tame or at least rein in the runaway urban sprawl voraciously consuming open space throughout America ever since the ignition of the post-World War II population and economic boom in the early 1950s. In 1973 the Oregon state legislature passed a landmark statewide comprehensive land use planning law (SB 100). Among other mandates, SB 100 required each existing municipality in the state to establish an urban growth boundary (UGB), in effect drawing a line in the sand (or through forests, farms, and ranches, in the case of Oregon), beyond which urbanization could not march willy-nilly – at least not without a conscious, informed, publicized decision. Each of Oregon's 241 cities and towns of 2,500 or more residents is surrounded by an urban growth boundary. Portland's UGB was the first established in 1979.

According to Professor Ethan Seltzer of the Nohad A. Toulan School of Urban Studies and Planning at Portland State University, the goal of UGBs was not to stop sprawl permanently at some arbitrary line, but to make the "conversion of land from rural to urban use a conscious and planned decision." He writes:

> Note that UGBs were never intended to be fixed limits imposed forever. Though they use regulation in a ways [sic] similar to the ways that greenbelts use time and distance to separate urban from rural, UGBs are intended to move as new land needs are demonstrated. Since 1970, Oregon's population has practically doubled, and the UGBs within which most of that growth has occurred have expanded to varying degrees to accommodate that population growth. However, each of those changes represents a conscious decision, made in concert with existing plans and according to the statewide planning goals.[2]

What has been the effect of the UGB law on stopping or at least slowing sprawl in Oregon? Professor Seltzer thinks the evidence is "both validating and inconclusive," and that Oregon is "losing farmland at rates substantially lower than its neighboring states and the national averages."

UGBs didn't prevent sprawl from engulfing the 419,800 acres (656 square miles) of open space developed between 1982 and 2015 mentioned above. But did they at least slow the rate of sprawl compared to other states, as Seltzer claims? One way of investigating this claim is to compare the land consumption per capita – or "sprawl per person" – of Oregon's lands developed between 1982 and 2015 with that same measure from other states. States with lower sprawl per person, that is higher population density, are more successful in curbing "per capita sprawl," the land developed to accommodate each additional resident. In **Table 1**, the Lower 48 states are ranked by their success in increasing the population density of newly developed land, thus reducing additional sprawl per capita.

Oregon is ranked a respectable sixth best out of the 48 contiguous states.

[2] Ethan Seltzer. 2013. Land Use Planning in Oregon: The Quilt and the Struggle for Scale. Lincoln Institute of Land Policy Working Paper. January 29. Accessed online 11-30-18 at: https://www.pdx.edu/usp/sites/www.pdx.edu.usp/files/Seltzer%20Lincoln%20Working%20Paper%20Land%20Use%20Planning%20in%20Oregon%20March%2020%202013%20%282%29.pdf

Table 1. Top Ten State Rankings of Area of Sprawl per Person in Newly Developed Land from 1982 to 2015
(lower number reflects less sprawl)

State	Total Sprawl (square miles), 1982-2015	Population Growth, 1982-2015	SPRAWL PER PERSON (acres)	Ranking (best to worst)
California	3,371	14,212,435	**0.152**	1
Nevada	478	2,001,520	**0.153**	2
Florida	4,239	9,797,160	**0.277**	3
Arizona	1,749	3,912,401	**0.286**	4
Utah	683	1,426,603	**0.307**	5
Oregon	**656**	**1,351,615**	**0.311**	**6**
Washington	1,406	2,876,266	**0.313**	7
Colorado	1,188	2,378,881	**0.320**	8
Maryland	859	1,717,638	**0.320**	9
Texas	6,191	12,123,465	**0.327**	10
All Contiguous 48 States	**67,161**	**88,615,912**	**0.485**	---

(Click here for a ranking of all states).

In terms of success in limiting the percentage increase in sprawl between 1982 and 2015 – or more precisely, minimizing the percentage increase in the area of the NRI's estimates of developed land over that 33-year period – Oregon ranks 33 out of 48 states. Thirty-two states experienced *more* sprawl, more rural lands developed, while 15 states experienced *less* sprawl. See the results of all 48 contiguous states in **Table 2**.

Sharp line of demarcation between residential subdivision just inside Portland's urban growth boundary and farmland just outside of it

Table 2. Percentage Increase in Sprawl by State, 1982-2015*

State	Percentage increase in Sprawl, 1982-2015	Ranking (worst to best)	State	Percentage increase in Sprawl, 1982-2015	Ranking (worst to best)
Nevada	136%	1	Maryland	56%	25
Arizona	113%	2	Washington	56%	26
Georgia	108%	3	Arkansas	53%	27
North Carolina	106%	4	California	53%	28
South Carolina	98%	5	Vermont	52%	29
Florida	96%	6	Michigan	49%	30
Utah	96%	7	Ohio	47%	31
Tennessee	89%	8	Oklahoma	47%	32
Kentucky	87%	9	**Oregon**	**43%**	**33**
New Mexico	85%	10	Indiana	42%	34
Delaware	85%	11	Minnesota	41%	35
New Hampshire	82%	12	Wisconsin	40%	36

State	Percentage increase in Sprawl, 1982-2015	Ranking (worst to best)	State	Percentage increase in Sprawl, 1982-2015	Ranking (worst to best)
West Virginia	82%	13	Missouri	39%	37
Alabama	78%	14	New York	36%	38
Texas	75%	15	Rhode Island	36%	39
Virginia	75%	16	Illinois	32%	40
Maine	72%	17	Montana	30%	41
Idaho	64%	18	Wyoming	30%	42
Mississippi	63%	19	Connecticut	29%	43
Colorado	63%	20	Kansas	23%	44
Pennsylvania	61%	21	Iowa	20%	45
Louisiana	59%	22	South Dakota	19%	46
New Jersey	58%	23	North Dakota	16%	47
Massachusetts	58%	24	Nebraska	15%	48

*Increase in area of developed land from 1982 to 2015, according to NRI, as a percentage of already developed land area in 1982.

1.2 A History of Growth Tensions

This NumbersUSA report for the State of Oregon examines the role of population growth in driving urban sprawl in the Beaver State. It is the latest in a series of state, regional, and national-level NumbersUSA sprawl studies that began in the year 2000 with a study on sprawl in California, the state once considered synonymous with urban sprawl in America. Indeed, taking note of California's runaway growth and the threat it posed to his beloved adopted state, former Oregon Governor Tom McCall (1913-1983), Oregon's 30th governor from 1967 to 1975, once pleaded, "Don't Californicate Oregon!" Alas, although it generated a good deal of publicity and criticism, his plea went largely unheeded.

Statue of Oregon's 30th governor: liberal Republican and environmentalist Tom McCall (1913-1983, governor from 1967 to 1975) on the Willamette River waterfront (Riverfront Park) in the state capital Salem.

Photo credit: Gary Halvorson, Oregon State Archives

According to one writer at Oregon Public Broadcasting, Governor McCall:

> …championed Oregon's quality of life and battled anything that seemed to threaten it. He put environmental protection ahead of economic growth. And he articulated a sense of place that, to this day, informs the way Oregonians think of themselves.[3]

McCall wasn't the only prominent Oregonian to oppose overpopulation in the state.

The James G. Blaine Society was an informal, tongue-in-cheek group founded in the early 1960s by the colorful Stewart Holbrook (1893 – 1964), a logger, writer, and historian, to protect Oregon from overpopulation.[4] According to *Wikipedia*, the society's goal, "is to discourage people from immigrating to Oregon." It was facetiously named in honor of James G. Blaine, a U.S. senator from Maine, precisely because he never visited Oregon. Back in the 1970s and 1980s, the society

[3] Eric Cain. 2013. Former Governor Tom McCall's Message To Visitors. Oregon Public Broadcasting. Accessed on 1-13-19 at: https://www.opb.org/artsandlife/article/former-governor-tom-mccall-message-visitors/

[4] The Society is described by *Wikipedia* at: https://en.wikipedia.org/wiki/James_G._Blaine_Society

was frequently cited in news media accounts about population growth in Oregon, despite having no official leadership, staff, or members.

Yet the anti-growth sentiment it reflected was likely shared by many conservationists in Oregon concerned about conserving their state's unique forests, farmland, water, and scenic beauty from the crush of too many people migrating to the state from elsewhere. Kolankiewicz, the lead author of this study, once worked as a fisheries biologist in another great northwestern state, Alaska, and in the following decade, as an environmental planner in Southern California. His former boss in the Alaska Department of Fish and Game, a fellow fisheries scientist, wrote to him in California that "his sacred mission as an environmental planner is to keep California just livable enough that all those millions of people won't move north." Unfortunately, he failed, and millions have moved north and east out of the once-Golden State, permanently impacting Oregon, Washington, Idaho, Nevada, Arizona, New Mexico, Texas, Colorado, and other states.

A message to visitors to the state of Oregon in the era of Governor Tom McCall

In the early 1980s, Oregon land use law faced an unprecedented challenge when thousands of followers of a controversial Indian spiritual guru named the Bhagwan Shree Rajneesh set out to build from scratch what they envisioned as a utopian community on an old ranch they purchased in Central Oregon. As recounted in the award-winning, six-part 2018 Netflix documentary series "Wild Wild Country," the "Rajneeshees" hoped that their model community of Rajneeshpuram would eventually reach a population of 100,000 in a thinly-populated, rural ranching region near the village of Antelope in Wasco County.

The Rajneeshees, in their zeal to build a large, visionary community based on "conscious living," often displayed flagrant disregard for established state and county land use laws, zoning

regulations, ordinances, and norms. They clashed not only with longstanding Antelope residents and their ranching neighbors, but with Wasco County planners, the land use watchdog group 1000 Friends of Oregon, and even legendary University of Oregon track coach and Nike co-founder Bill Bowerman, who hailed from a ranching family in the area. Ultimately, the Rajneeshees were driven out, Rajneeshpuram was shut down, the Bhagwan was deported, and several leaders in the cult were convicted of various felonies that led to prison sentences.

After World War II, America's booming population and affluence led to a booming appetite for natural resources – timber, water, arable soils, electricity, coal, oil, natural gas, minerals, metals – the consumption of which underwrote this growth. It also led to ever-increasing environmental impacts from the "residuals" (waste products and byproducts) of the economic processes of production and consumption discharged into the air, water, and land. At the same time, increasing educational levels in America's population engendered growing awareness of, and concern for, our rising impacts on natural resources and the environment.

It was all but inevitable that a political advocacy campaign would emerge – the so-called "environmental movement" of the 1960s – which would clash with the "business as usual" forces of both private sector and public (and quasi-public) sector development efforts (e.g., dams, reservoirs, river channelization, irrigation schemes, canals, flood control projects, interstate highway system) that had previously been welcomed without question as "progress." Now, for the first time in American and world history, so-called progress was being called into question and the authorities who promoted it called to account. "Not blind opposition to progress, but opposition to blind progress," went the quote variously attributed to Sierra Club stalwarts John Muir and David Brower.

Oregon, like many resource-rich and beautiful Western states, was on the front lines of the struggle over how (and whether) to use, manage, and conserve the land and its treasure troves of natural resources. Should ancient, never-before-logged coniferous forests on the western slopes of the Cascades be harvested to provide jobs for loggers and sawmill workers, as well as important wood products for society, or should they be preserved to safeguard beauty for human appreciation and habitat for imperiled species such as the Northern Spotted Owl and the Marbled Murrelet? Should growing towns and cities be permitted to expand haphazardly across the landscape, devouring farmland, ranchland, range, and wildlife habitats as residential subdivisions and strip malls spread ever outward under the pressure of relentless population growth? Oregonians had to wrestle with these difficult and divisive issues.

Oregon is blessed with both spectacular natural beauty and wilderness and with natural resources whose development and consumption provide jobs and needed materials for our industrial economy (Crater Lake National Park)

The Marbled Murrelet (*Brachyramphus marmoratus*) is a seabird that nests high in the branches of old-growth forests along Pacific Northwest coasts, including Oregon's.

In 1971, Oregon became the first state in the union to pass a "bottle bill" (container deposit legislation) aimed at reducing roadside litter, encouraging recycling, and reducing landfill-clogging waste. As noted above, in 1973 the Oregon state legislature also passed the landmark statewide comprehensive land use planning law (SB 100) that required each municipality to establish an urban growth boundary (UGB) in an effort to slow sprawl and save open space.

Yet by the late 1990s, Oregon's population had grown more than twenty percent in the previous decade alone. If that growth rate were to continue, the state's population would double in less than four decades. And commensurate with that population growth was an unprecedented increase in resource consumption."[5] Oregon was beginning to experience scarcity and shortages of desirable public goods – of energy, clean air and water, wilderness, virgin forests, wetlands, and Pacific salmon – at the same time that state residents were having to contend with increases in "public bads," in traffic congestion, air pollution, water pollution, classroom crowding, and local tax increases.

The Willamette Valley Livability Forum had projected in the early 2000s that within four decades – even with implementation of top-notch conservation practices – the Willamette Valley would lose 150,000 acres of farmland, 25,000 acres of forests, and would add some 63,000 acres to developed areas within the UGBs.[6]

In the face of these growth-related challenges, in 1997, a group of concerned Oregonians met to discuss growth and economic issues in the state.[7] They recognized that for a quarter century, Oregon had been a national leader in using the planning process to address growth issues, enacting some of the most stringent land use laws in the country. While these efforts had succeeded in slowing sprawl and protecting some areas, the incessant population growth left them unable to halt the loss of farmland, forest lands, open space, and wildlife habitat, as evinced by the NRI data reviewed above.

The group of concerned Oregonians recognized that in the face of continuing increases in population and per capita consumption, growth management alone would not be enough to save the state's rural lands, open space, agriculture, and natural habitats. That 1997 meeting resulted in a statewide conference attended by 600 Oregon residents and in late 1999 led to the creation of a non-governmental organization (NGO) called Alternatives to Growth Oregon (AGO). Chaired by veteran conservationist Andy Kerr and vice-chaired by David Johns, AGO aimed to:

> …educate Oregonians about the true costs and consequences of unending growth, to advocate for a change in state and local policies that promote growth without thought to the costs and consequences, and perhaps most importantly to develop and help to implement alternative economic strategies and policies that will allow the Oregon economy to flourish, primarily at the local level, and in a

[5] Alternatives to Growth Oregon. About AGO. Accessed at: http://www.agoregon.org/page34.htm
[6] Ibid.
[7] Idid.

> manner which addresses and resolves issues of social and economic equity and environmental stewardship.[8]

AGO's mission was to:

> …leave succeeding generations of Oregonians a more economically prosperous, environmentally healthy, and socially just State by encouraging progress toward a sustainable society and discouraging growth that depends on increased population and consumption. This stricture applies only to **physical growth**. We recognize that growth in educational opportunities, civic participation, environmental stewardship, social and moral well-being, artistic expression…are both possible and desirable.[9]

Just five years later, AGO was forced to close its doors, suspending operations indefinitely in 2004 due to insufficient funds. AGO was a victim of both the slowing economy after the "Dot-Com Bubble" stock market crash in 2000 and the terrorist attacks on September 11, 2001.[10] Both of these shocks were hard on all of America's NGOs – they hurt new member recruitment, maintenance of the existing membership base, and funding from foundations, which had seen their portfolios crash in net value. Another factor was at work as well:

> Compounding this shortage of resources has been the unprecedented assault on the environment by the Bush Administration and Congress. Foundations and donors have had no choice but to concentrate their funding on mostly defensive efforts. AGO's big-picture and very-long-term mission lost out to the more pressing short-term needs of organizations coping with these unprecedented assaults.[11]

AGO's founders were also well aware of a certain unfortunate irony, namely that:

> AGO's short-term ability to continue its long-term mission to move Oregon toward a sustainable economy was harmed by the 'slowdown' in Oregon's economy. Rather than racing down the road at 100 miles per hour, the Oregon economy has slowed to 99 mph. Rather than seeking alternatives to growth many political, business and civic leaders are determined to ignore the results of past practices and simply speed up the economy.[12]

The upshot of this brief overview of growth in Oregon and citizens' efforts to restrain it through both activism and government decree, culminating in the short-lived existence of AGO and its closure in 2004, is that Oregon, like every community and state in the country, is "hooked on growth." The political and economic pressure to accommodate and encourage that growth is overwhelming when the population of the United States is increasing in the range of 20 to 30 million or more every decade – decade after decade – with no end in sight.

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8 Ibid.
9 Ibid.
10 Alternatives to Growth Oregon. AGO Suspends Operations. Accessed at: http://www.agoregon.org/
11 Ibid.
12 Ibid.

Livestock grazing on Oregon rangeland

The scenic Oregon coast is beloved by photographers and wanderers alike

Photo Credit: Vasiliki Volkova

2. SPRAWL IS STILL A PROBLEM AFTER ALL THESE YEARS (AND AMERICANS AND OREGONIANS ARE STILL CONCERNED)

When NumbersUSA published its first national level study on sprawl in 2001,[13] 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.[14] Nineteen years later, sprawl is still devouring valuable farmland and wildlife habitat, both in Oregon and nationwide. But national and state environmental groups, by and large, have shifted their focus to other issues and away from the loss of habitat and open space due to the unsustainable outward expansion of cities in America.

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 ten years from 2002 to 2012 approximately 8.75 million acres (about 13,670 square miles) – an area larger than Maryland – of previously undeveloped land succumbed to the bulldozer's blade.

Although urban sprawl by name is not particularly evident 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. A 2014 survey of likely American voters revealed that 77 percent thought that the destruction of farmland and natural habitat because of urban sprawl was a "major problem" (42%) or "somewhat of a problem" (35%). Eighty-five percent responded that the loss of natural wildlife habitat to growing cities was "very" (53%) or "somewhat" (32%) significant.[15]

Oregonians share these concerns with other Americans. In October 2019, NumbersUSA commissioned a survey of 1,000 likely voters in Oregon conducted by the polling firm Pulse

[13] 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/resource-article/weighing-sprawl-factors-large-us-cities-2001 and https://www.numbersusa.com/sites/default/files/public/from_drupal5/pdf/LargeCity%20Sprawl.pdf.

[14] 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.

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

Opinion Research.[16] Questions 6-9 in the survey pertain to the importance Oregonians place on protecting farmland and saving and easily accessing natural areas in the state.

6* Thinking about agricultural land in Oregon, are you very concerned, somewhat concerned, not very concerned or not at all concerned about the ability to protect farmland from development?

45% Very concerned
36% Somewhat concerned
12% Not very concerned
3% Not at all concerned
3% Not sure
GROUPINGS: 81% VERY or SOMEWHAT concerned
15% NOT VERY or NOT AT ALL concerned

7* Is it unethical to pave over and build on good farmland or are the demands of a growing population a legitimate reason to pave over and build on farmland?

66% It is unethical to pave over and build on good farmland
19% The demand for more housing is a legitimate reason to pave over farmland
15% Not sure

8* How important is it to save the natural areas and open spaces that remain in Oregon?

71% Very important
22% Somewhat important
4% Not very important
1% Not at all important
2% Not sure
GROUPINGS: 93% VERY or SOMEWHAT important
5% NOT VERY or NOT AT ALL important

9* How important is it that you can easily spend time in natural areas near where you live?

70% Very important
24% Somewhat important
3% Not very important
1% Not at all important
1% Not sure
GROUPINGS: 94% VERY or SOMEWHAT important
4% NOT VERY or NOT AT ALL important

[16] Pulse Opinion Research. 2019. Oregon Survey of 1,000 Likely Voters. Conducted October 29-29, 2019. Most questions have a Margin of Sampling Error of +/- 3 percentage points with a 95% level of confidence. See Appendix E of this study for entire poll.

Oregon in the 1982-2015 period has been measured by the National Resources Inventory (NRI), conducted by the United States Department of Agriculture (USDA)'s Natural Resources Conservation Service (or NRCS, formerly the Soil Conservation Service or SCS). During that time, it found approximately 656 square miles (419,800 acres) of open space in Oregon were converted into housing, shopping malls, streets, schools, government buildings, waste treatment facilities, parking lots, vacation homes, resorts, highways, and places of work, worship, and entertainment.[17]

As native-born Oregonians and newcomers to the state seek jobs and better economic opportunities, Oregon's towns and cities have sprawled ever further outward. This new development puts pressure on natural resources, habitats, and species in many ecologically sensitive areas. It is for these reasons that the authors decided that Oregon warrants its own study on population growth and sprawl. In studying the factors that cause sprawl, we have previously conducted three national-level studies (2001, 2003, and 2014), two on Florida (2000 and 2015), one on California (2000), one on the Chesapeake Bay watershed (2003), one on the Southern Piedmont (portions of North Carolina, South Carolina, and Georgia) in 2015-2016, and one on Texas (2017). These studies are available at the NumbersUSA website, www.numbersusa.org and have been cited numerous times worldwide in technical and popular literature.

This Oregon study examines the quantity and rate of rural land lost to development surrounding the state's ten Urbanized Areas (UAs – entities defined by the Census Bureau as central cities and the contiguous development of their suburbs). In these 10 UAs alone, 97 square miles (62,131 acres) of surrounding rural land were lost to urbanization during the most recent decade between the 2000 Census and the 2010 Census (**Table 3**). We also examine the two principal factors behind this sprawl, determining the degree to which population growth and growth in per capita land consumption (decreasing population density) each "drove" sprawl from 2000 to 2010.

With regard to **Table 3**, it is important to note that the amount of sprawl that occurred around these 10 UAs by no means encompasses all sprawl and land development that occurred throughout the entire state. Sprawl also took place around smaller cities and towns and that smaller-scale sprawl is not captured in this table; in aggregate, it is substantial.

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

[17] USDA Natural Resources Conservation Service (NRCS). 2018. *2015 National Resources Inventory, Summary Report* (September). Accessed online July 2019 at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd1422028.pdf .

Table 3. Oregon Urbanized Areas Ranked by Amount of Sprawl from 2000 to 2010

Urbanized Area	Sprawl (sq. miles)	Sprawl (acres)
1. Portland, OR-WA	50.4	32,282
2. Eugene, OR	18.3	11,680
3. Albany, OR	7.7	4,954
4. Salem, OR	6.7	4,288
5. Medford, OR	6.0	3,859
6. Longview, WA-OR	6.0	3.840
7. Walla Walla, WA-OR	4.7	2,989
8. Bend, OR	3.3	2,125
9. Grants Pass, OR	1.8	1,152
10. Corvallis, OR	-7.9	-5,037
Total open space lost to sprawl around the edges of the 10 Oregon urbanized areas	**97.1**	**62,131**

Source: U.S. Census Bureau Urbanized Area data for Oregon for 2000 and 2010

2.1 Loss of Farmland, Wildlife Habitat, and Open Space

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 their 2007 summary report, reviewing the 1982-2007 quarter-century for the country as a whole:

> The net change of rural land into developed land has averaged 1.6 million acres per year over the last 25 years, resulting in reduced agricultural land, rangeland, and forest land. Loss of prime farmland, which may consist of agriculture land or forest land, is of particular concern due to its potential effect on crop production and wildlife.[18]

Nationwide, from 1982 to 2015, about 43 million acres (68,750 square miles) – an area about equal to the state of Florida – of previously undeveloped non-federal rural land was paved over to accommodate our growing cities and towns. Of these 43 million acres lost – or "converted" as land managers and planners generally refer to it – approximately 18.8 million acres were forestland, 11.1 million acres cropland, and 13.1 million acres pasture and rangeland.

In Oregon, according to the NRCS, the amount of developed land increased by 43 percent in the 33 years between 1982 and 2015, from 974,000 acres (1,522 square miles) to 1,393,800 acres (2,178 square miles). **Table 4** and **Figure 1** show the relentless increase in developed land in Oregon at five-year intervals from 1982 to 2015. It is worth reiterating once more

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

that all of the land developed during this 33-year period was land taken permanently from Oregon's agricultural land base or its natural habitats. These lost croplands, pasturelands, rangelands, open spaces, and wildlife habitats are irreplaceable on any relevant time scale.

On average, on each of the 12,053 days in the 33 years between 1982 and 2015, approximately 35 acres of open space in Oregon 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 33-year time period, from 43 acres per day in the early 1990s to a peak of 60 acres per day in the late 1990s, and back down to 9-10 acres per day by 2007 to 2015, a reflection of increasing population density and also a response to the Great Recession of 2008 and its aftermath.

Table 4. Cumulative Increase in Developed Land in Oregon, 1982-2015

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	974.0			
1987	1,062.2	1982-1987	17,640	48
1992	1,140.1	1987-1992	15,580	43
1997	1,249.0	1992-1997	21,780	60
2002	1,316.2	1997-2002	13,440	37
2007	1,365.0	2002-2007	9,760	27
2012	1,383.8	2007-2012	3,760	10
2015	1,393.8	2012-2015	3,330	9
Average		**1982-2015**	**12,721**	**35**

Source: Calculated from NRCS, 2018. *Summary Report: 2015 National Resources Inventory*, Table 1.

In Oregon and around the world, many patches of earth have succumbed to the bulldozer's blade.

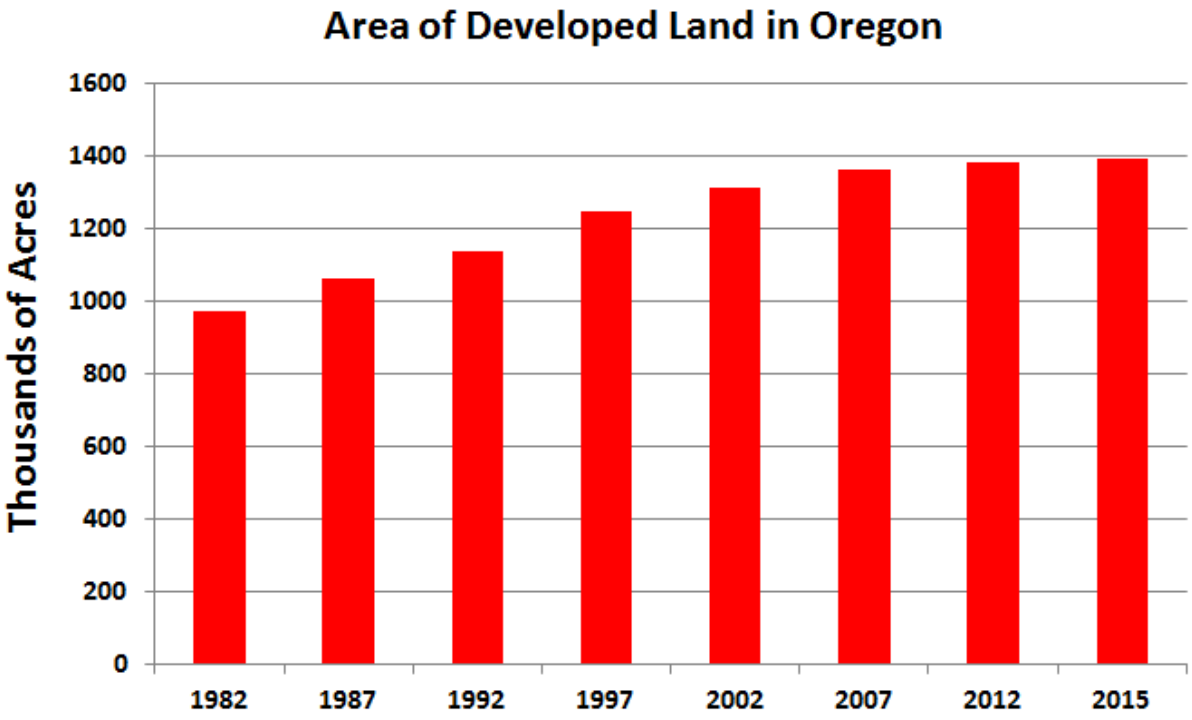


Figure 1. **Growth in Acreage of Developed Land in Oregon, 1982-2015**
Data Source: Table 1 in *2015 National Resources Inventory, Summary Report* (NRCS, 2018)

The area of cropland in Oregon decreased by 685,800 acres (16 percent) from 1982 to 2015. Some of this land was protected under the Conservation Reserve Program (CRP), some was retired from cultivation and converted to pastureland, rangeland, and other rural lands. However, some of it was also developed. "Asphalt is the land's last crop," observed former U.S. Assistant Secretary of Agriculture and conservationist Rupert Cutler back in the 1970s.[19] Once a piece of ground 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.

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.[20] 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.[21] 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.[22]

It is estimated that about one-third of new houses in the United States are now constructed in undisturbed natural habitats.[23] Roads connecting newly built residential subdivisions and commercial development break up the landscape and create hazards and barriers through wildlife home ranges.[24] As any motorist knows from observing the carnage of roadkill, paved roads and streets are deathtraps for hapless vertebrates: mammals, reptiles, amphibians, and

[19] Lester R. Brown and Ed Ayers (eds.), 1998. *World Watch Reader on Global Environmental Issues*. W.W. Norton & Company (New York, London).
[20] The Wildlife Society. Fact Sheet – Wildlife Habitat Fragmentation. Available at: http://wildlife.org/wp-content/uploads/2014/05/Wildlife-Habitat-Fragmentation.pdf.
[21] 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.
[22] Ibid.
[23] Radeloff, V. C., R. B. Hammer, S. I. Stewart, J. S. Fried, S. S. Holocomb, and J. F. McKeefry. 2005. The wildland-urban interface in the United States. *Ecological Applications* 15:799-805.
[24] 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.

even some birds. An estimated one million animals are killed on American roads every day.[25] Roadkill is now 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.[26] One recent 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.[27]

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 (31 miles) of protected areas in the United States, and 940,000 homes were even constructed on private inholdings within national forest boundaries.[28]

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

[25] 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.

[26] 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; Francis, C., C. Ortega, and A. Cruz. 2009. Noise Pollution Changes Avian Communities and Species Interactions. *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.

[27] 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.

[28] 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.

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 growth contributes to urban expansion more in North America than in Europe,[29] 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.[30]

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.[31]

2.2 Threatened Species and Habitats

Within the overall open-space acreage threatened by sprawl are 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.[32] The United States is home to over 1,000 endangered or threatened animal and plant species and sub-species that are seriously harmed by ever-encroaching development.[33]

Endangered species 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.

[29] 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.
[30] Ibid.
[31] 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.
[32] World Wildlife Fund. 2019. Nobody knows how many species are being lost each year, nor the total number of species that exist. Accessed 7-17-19 at: https://wwf.panda.org/our_work/wildlife/problems/.
[33] U.S. Fish and Wildlife Service. 2019. Endangered Species. Accessed 7-17-19 at: https://www.fws.gov/endangered/species/us-species.html.

Threatened species or sub-species may become endangered within the foreseeable future. In Oregon, plants or animals may be protected under the authority of state law (Oregon Endangered Species Act) and/or under the Federal Endangered Species Act (ESA). Two examples of federally-listed species in Oregon are the aforementioned Marbled Murrelet (*Brachyramphus marmoratus*), and the Northern Spotted Owl (*Strix occidentalis caurina*), both of which depend on old-growth forests. The agency responsible for implementing the ESA – the U.S. Fish and Wildlife Service (USFWS) – lists both of these birds as threatened.

Family of Northern Spotted Owls
Photo: U.S. Fish and Wildlife Service

The Oregon Department of Fish and Wildlife maintains a list of vertebrates (mammals, birds, reptiles, amphibians, and fish) occurring in Oregon that are listed as threatened or endangered by the USFWS and/or the State of Oregon, or are formal candidates for such listing. This list has to be continually updated because of constant changes in the status of imperiled species on the brink of extinction, but as of 2018 there were 16 mammal species and subspecies, eight birds, four reptiles, one amphibian, and 25 fish on this list.[34] The survival of each of these species is jeopardized in one way or another by humans.

The lone amphibian on the list is the Oregon spotted frog (*Rana pretiosa*), which was designated as threatened by the USFWS in 2014. In Oregon, this frog species is known to survive only in Wasco, Deschutes, Klamath, Jackson and Lane counties, although historically it also occurred in Multnomah, Clackamas, Marion, Linn, and Benton counties. Among the factors believed to have led to its decline are loss of habitat, invasive plants, and the introduction of exotic predators. Over 95 percent of its historic marsh habitat has disappeared

[34] Oregon Department of Fish and Wildlife. 2018. Threatened, Endangered, and Candidate Fish and Wildlife Species. Accessed online 7-17-19 at: https://www.dfw.state.or.us/wildlife/diversity/species/threatened_endangered_candidate_list.asp

in the Willamette and Klamath basins. The USFWS notes that changes in hydrology from construction of ditches and dams, water quality problems, development, and livestock overgrazing continue to damage, destroy, or fragment its habitats.[35]

Oregon Spotted Frog
Photo: U.S. Fish and Wildlife Service

Non-native plant invasions by such aggressive species as reed canarygrass (*Phalaris arundinacea*), and succession of plant communities from marsh to meadow also threaten the Oregon spotted frog's existence. Introductions of bullfrogs and non-native fishes have affected this species both directly, by eating them, and indirectly, by outcompeting or displacing them from their habitat.

Two of the listed mammals are the federally-threatened Canada lynx (*Lynx canadensis*) and the state-threatened wolverine (*Gulo gulo*). Both of these magnificent predators are threatened by greater human intrusion into their habitats.[36]

[35] U.S. Fish and Wildlife Service. Oregon Spotted Frog. Accessed 7-17-19 at: https://www.fws.gov/oregonfwo/articles.cfm?id=149489458.
[36] U.S. Fish and Wildlife Service. Oregon Fish and Wildlife Office: Canada Lynx. Accessed online at: https://www.fws.gov/oregonfwo/articles.cfm?id=149489424.

Canada Lynx
Photo: U.S. Fish and Wildlife Service

A 2019 study by Conservation Science Partners[37] of the loss and fragmentation of natural areas in the conterminous United States identified four types of stressors. agriculture (including timber harvest), energy (both conventional and renewable), transportation (highways and other roads), and urban (residential, commercial, industrial, etc.). The study concluded that expansion and intensification of land uses in the U.S. resulted in the steady, relentless loss of natural areas in the 16 years between 2001 and 2017. During this time period, over 24 million acres of natural lands and habitats were permanently modified or lost to development, a large area roughly equivalent to almost nine Grand Canyon National Parks, more than 10 Yellowstone National Parks, or 49 Great Smoky Mountains National Parks. More than 1.5 million acres were lost annually, on average. Total losses by stressor are shown in **Table 5**.

Table 5. Acres of Human Modification of Natural Lands in the U.S. by Major Stressor from 2001 to 2017

Major Stressor	Acres
Agriculture	1,441,000
Energy	6,188,000
Transportation	2,580,000
Urban	13,809,000
Total acreage of natural lands lost	**24,018,000**

Source: Conservation Science Partners. 2019. Loss and fragmentation of natural lands in the conterminous U.S. from 2001 to 2017. Footnote #39.

[37] Conservation Science Partners. 2019. Loss and fragmentation of natural lands in the conterminous U.S. from 2001 to 2017. Executive Summary. 18 January. Authored by D.M. Theobald, I. Leinwand, J.J. Anderson, V. Landau, and B.G. Dickson. Submitted to The Center for American Progress.

As shown in **Table 5**, the urban stressor accounted for more loss of natural lands than all other three stressors combined. The urban stressor alone was responsible for 57% of all natural lands lost during the 16-year study period. Urban sprawl destroys more natural habitat in the United States than any other or than all other major causes combined.

2.3 Stability of Ecosystems and the Biosphere

Eliminating forests and wetlands not only threatens native species, but has serious human health, safety, and economic consequences as well. Wetlands are important filters that clean pollutants out of our water. Wetlands can also moderate the devastating effects of floods by acting as natural buffers and sponges, soaking up and storing floodwaters. According to the Environmental Protection Agency, nearly two-thirds of all fish we consume spend some portion of their lives in wetlands, which often serve as "nurseries" for juveniles. Continuing to pave over our nation's valuable habitats with unrelenting sprawl entails serious long-term economic and human health and safety costs that we simply cannot afford.

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, replaced by biologically impoverished artificial habitats dominated by human structures and communities, contributes cumulatively to what may become a "state shift" or "tipping point" in Earth's biosphere. This would be an uncontrollable, rapid transition to a less desirable condition in which the biosphere's ability to sustain us and other species would be severely compromised. A 2012 paper in the prestigious British scientific journal *Nature* reviews the evidence that: "…such planetary scale critical transitions have occurred previously in the biosphere, albeit rarely, and that humans are now forcing another such transition, with the potential to transform Earth rapidly and irreversibly into a state unknown in human experience."[38]

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an independent intergovernmental body established in 2012. It now includes over 130 member states around the world.[39] The IPBES's 2019 Global Assessment Report on Biodiversity and Ecosystem Services examined the state of nature and ecosystems globally, and their contributions to humankind. This large, extensive, multidisciplinary investigation revealed that the human footprint on the biosphere is so prodigious that it leaves little room for wild, pristine nature. Approximately three-quarters of all land surfaces on the Earth has been converted to agriculture or covered up by concrete, asphalt, artificial structures, large reservoirs, or otherwise modified. Two-thirds of all marine environments has been severely impaired in the past century. The biomass of wild mammals has fallen by 82 percent, and

[38] Barnosky, A.D. et al. 2012. "Approaching a state shift in Earth's biosphere." *Nature*, Vol. 486, 7 June.
[39] IPBES. 2019. Global Assessment Report. Available online at: https://lp.panda.org/ipbes.

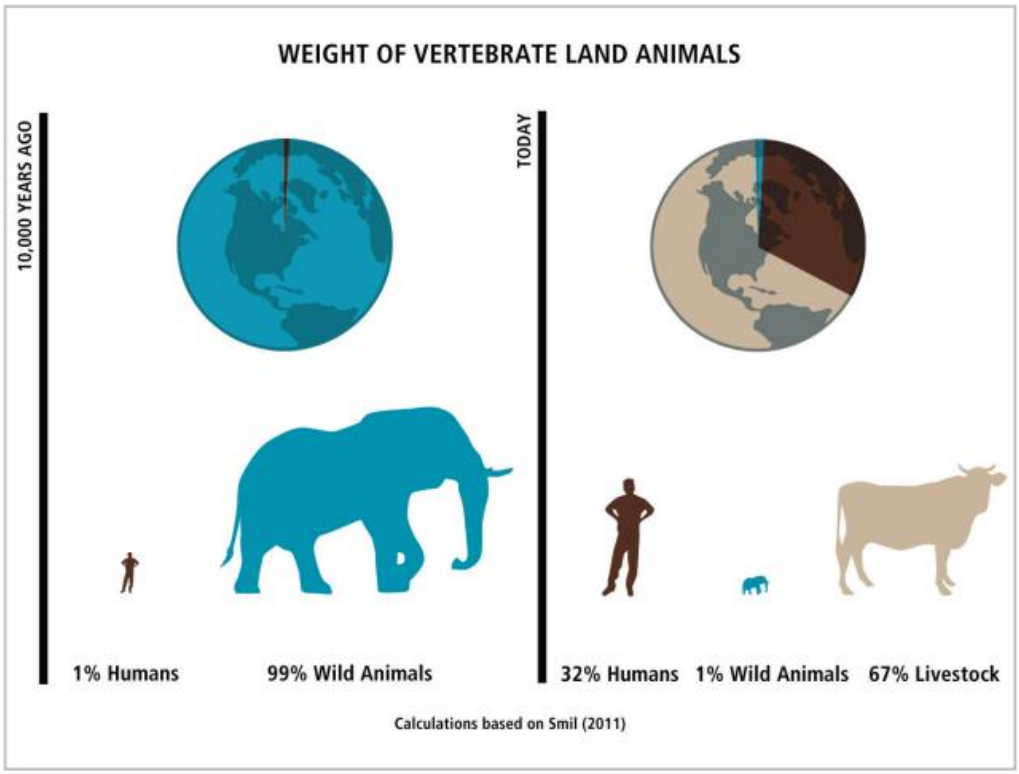
overall, one million species are at risk of extinction due to the sheer breadth and depth of all human activities.

According to key drivers of harmful alterations of ecosystems, in decreasing order of impact:

- Changes in land and sea use (conversion of natural habitats to artificial ones)
- Direct exploitation of organisms (e.g., hunting, harvest, fishing)
- Climate change
- Pollution
- Invasive alien species

All of these, of course, are attributable to rapidly increasing levels of human population and activity. The Assessment observed that: "In the past 50 years, the human population has doubled." Assessment co-author Kate Brauman, lead scientist of the Global Water Initiative at the University of Minnesota's Institute on the Environment, noted: "Nature is changing in part because there's more of us and we are consuming more."

A sense of the great extent to which humans have expropriated the biosphere for our own ends – and literally converted large swaths of it into us and our "stuff" (domestic animals, in this case) – is revealed by **Figure 2**.



Source: *The Overpopulation Project, Population Matters.*

Figure 2. **Human Expropriation of the Biosphere 10,000 Years Ago vs. Today**
(Based on the research of University of Manitoba ecologist Vaclav Smil)

A 2019 study out of Oregon State University identified forests in the western United States that warrant preservation for their potential both to sequester carbon (thereby helping to mitigate climate change) and enhance biodiversity.[40] As shown in **Figure 3,** Oregon and neighboring Washington possess virtually all of the high carbon priority forests in the western U.S. The authors told the website Phys.org that: "preserving temperate forests in the western United States that have medium to high potential carbon sequestration and low future climate vulnerability could account for about a third of the global mitigation potential previously identified for temperate and boreal forests. Co-author Beverly Law of Oregon State added that: "At the same time, it would promote ecosystem resilience and maintenance of biodiversity. We are in the midst of a climate crisis and a biodiversity crisis. Preserving these forests is one of the greatest things we can do in our region of North America to help on both fronts."[41]

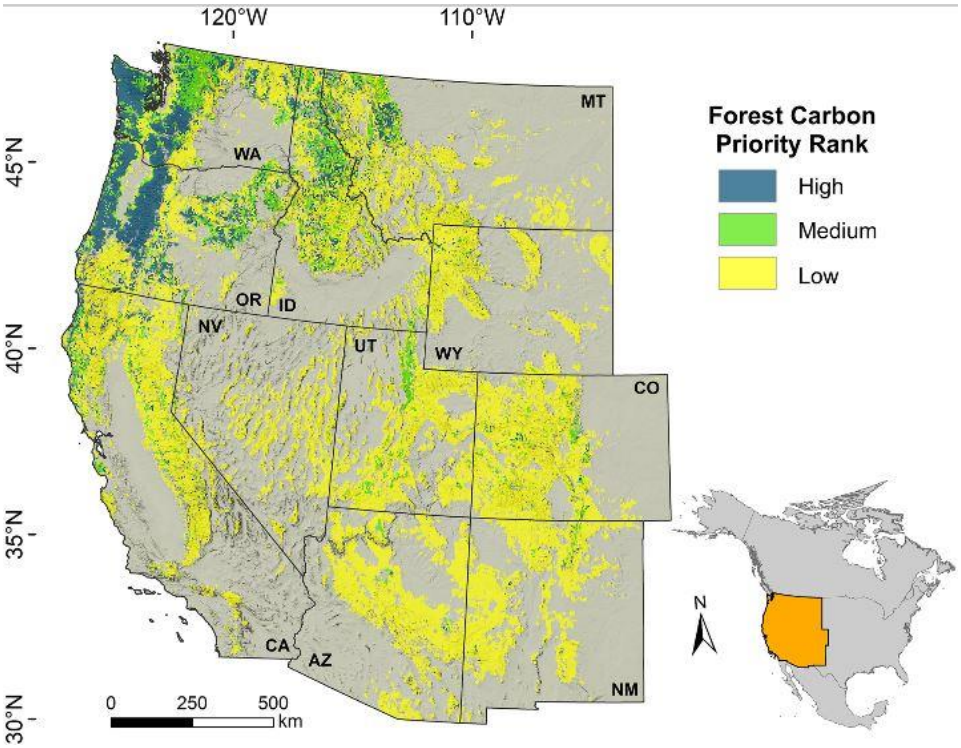


Figure 3. Forest Carbon Priority Rank of Western U.S. Forests

[40] Polly C. Buotte, Beverly E. Law, William J. Ripple, Logan T. Berner. 2019. Carbon sequestration and biodiversity co-benefits of preserving forests in the western USA. *Ecological Applications*. Ecological Society of America. Available online at: https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1002/eap.2039

[41] Steve Lundeberg. 2019. Researchers find some forests crucial for climate change mitigation, biodiversity. Phys.org. December 9. Available online at: https://phys.org/news/2019-12-forests-crucial-climate-mitigation-biodiversity.html.

2.4 Agriculture and Food Security

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.[42] 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."[43] While this may in fact constitute a healthier diet, it would also represent a significant loss of choice for a country that has always prided itself on its abundant agriculture, affordable food, plentiful consumer options, and comparative freedom from want.

From 1982 to 2015, Oregon experienced a decline of 16 percent in the area of its cropland between 1982 and 2015, compared to 13 percent of cropland decline nationally (in all 48 contiguous states). Twenty-seven states lost a higher percentage of cropland, while 17 states lost a lower percentage, and one state, only one (South Dakota), actually gained cropland during these 33 years.

Oregon also experienced a decline of 13 percent of its pastureland over the same period, compared to the seven percent national rate.[44] Thus, in spite of its efforts to limit sprawl and preserve farmland, the state performed more poorly than the national average in saving these two main categories of farmland. On rangeland, a third category of rural land used for the nation's food production – by supporting livestock (cattle, sheep, goats) – Oregon lost two percent between 1982 and 2015, compared to a three percent national average, so the state slightly outperformed the nation as a whole.

Oregon experienced essentially no change in the area of non-federal forestlands, about equal to the national average, which was a one percent increase – one of the few bright spots.

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

[43] Pimentel and Giampietro. 1994. See footnote #43.

[44] Included in the NRI are cropland, pastureland, rangeland, and forestland in private ownership, tribal and trust lands, and lands controlled by State and local governments. Excluded from the NRI are cropland, pastureland, rangeland, and forestland in national parks, national forests, national wildlife refuges, and Bureau of Land Management and Department of Defense lands (Navy, Marines, Army, Air Force bases).

(Click **here** to see data on lost Copland, Pastureland, and Non-Federal Rangelands for each of the 48 contiguous states.)

It needs to be emphasized that, on the national scale, only a fraction of the acreage lost in each of the cropland, pastureland, and rangeland categories was actually converted to developed land. With regard to cropland, for example, most of the reduction nationally between 1982 and 2015 (more than 53 million acres or approximately 83,000 square miles) was due to conversion not to developed land but rather to pastureland or to protection through enrollment in the federal Conservation Reserve Program (CRP), which provides incentives (rental payments) to farmers not to subject more environmentally sensitive and marginal (fragile, steeper, erosive) agricultural lands to plowing and cultivation. CRP contracts are not permanent but are a type of easement that typically extends for 10-15 years.[45]

Seltzer (2013) states that:

> Oregon is losing farmland at rates substantially lower than its neighboring states and the national averages….The effort to protect Oregon farmland is measurably succeeding…

The above presentation and analysis of the NRCS's most recent 2015 NRI data contradicts the Seltzer assertion that Oregon is losing farmland at rates "substantially lower" than neighboring states and national averages. Indeed, farmland loss in the Beaver State over the past four decades somewhat exceeds the national average in the two most important categories (cropland, pastureland). One of the reasons for this is that Oregon's population growth exceeds the national average. Oregon's population grew by 51 percent from 1982 to 2015, compared to a national growth rate (in the 48 contiguous states) of 39 percent.

Table 6 documents the decline in Oregon's cropland acreage from 1982 to 2015. In that 33-year span, croplands declined by 685,800 acres, or 16 percent. Some of that cropland was not urbanized or paved over, but rather converted to other types of rural lands. pastureland, rangeland, forestland, or the conservation reserve program (CRP). Nevertheless, a 16 percent decline still represents a striking loss in the amount of croplands in just three decades.

[45] USDA Farm Services Agency. Conservation Reserve Program. Accessed online 1-10-19 at: https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/

Table 6. Decline in Oregon Croplands, 1982-2015*

Year	Cropland
1982	4,289.8
1987	3,902.6
1992	3,707.2
1997	3,697.5
2002	3,630.9
2007	3,525.9
2012	3,521.6
2015	3,604.0

*In thousands of acres

Source: NRCS, 2018. *2015 National Resources Inventory: Summary Report*, Table 2**.**

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.[46] 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.[47] As Oxford ecology professor Norman Meyers noted in a now-classic 1986 article:

> …national security is not just about fighting forces and weaponry. It relates to watersheds, croplands, forests, genetic resources, climate and other factors that rarely figure in the minds of military experts and political leaders…[48]

One of the lasting consequences for 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 enhance and ensure their food supplies. Among the food-

[46] 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.
[47] Tweeten, L. 1998. Food Security and Farmland Preservation. *Drake Journal of Agricultural Law*. 3:237-250.
[48] 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.

importing countries with large populations or high population density, limited arable land and domestic agriculture, and overall food security concerns making these investments are China, South Korea, India, Saudi Arabia, the United Arab Emirates, and Qatar. 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.[49]

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.[50]

Finally, U.S. agriculture and related food industries contribute nearly $1 trillion to our national economy annually. They comprise more than 13 percent of American 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.[51]

Americans are not unaware of these national security implications, according to a 2014 poll[52] of likely voters (see Appendix F for the entire poll results). Some 92 percent thought that it was very important or somewhat important for the U.S. to be able to produce enough food domestically to be able to feed its own population in the future:

> 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

[49] 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.

[50] 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/.

[51] United Nations Food and Agricultural Organization (FAO). 2009. Global agriculture towards 2050. Available online at: http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf .

[52] Op. cit. Footnote #18, Pulse Opinion Research. Appendix F includes the entire poll's results.

Two related questions in this 2014 poll pertained to the importance of feeding foreigners with U.S. agricultural exports and the ethics of paving over good cropland even for as legitimate a reason as providing additional housing:

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

It is obvious from these survey results that most Americans believe that protecting productive farmland is a national priority.

2.5 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-being, and a feeling of harmony with the world around us. The presence of open space within and adjacent to our urban areas – and the assurance that this open space will outlast us – serves to counter-balance the stress and strain of modern life.

Central Park Has Been Called a "Green Oasis" in New York City

Contact with nature and open space provides both physiological and psychological benefits. Research on the physiological benefits of open space has centered on how direct or indirect (vicarious) experience with vegetated and/or natural landscapes reduces stress, and anxiety.[53] A series of studies spanning nearly 20 years in the 1970s and 1980s 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.[54] In studies of hospital patients, recovery was faster, there were fewer negative evaluations in patient reports, and there was less use of analgesic drugs among post-surgery patients with views of exterior greenery than among control group patients with views of buildings.[55]

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

[53] Rubenstein, N.R. The Psychological Value of Open Space. Chapter 4 in *The Benefits of Open Space*. The Great Swamp Watershed Association. 1997.
[54] Ulrich, R. 1979. Visual landscapes and psychological well-being. *Landscape Research*, 4(1): 17-23.
[55] 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.

of life.[56] 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.[57]

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.[58]

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.[59] 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.[60]

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[56] Cimprich, B. E. 1990. Attentional fatigue and restoration in individuals with cancer. Unpublished Doctoral Dissertation, University of Michigan.
[57] 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.
[58] Kaplan, R., & Kaplan, S. (1989). *The Experience of nature: A Psychological perspective*. New York: Cambridge University Press.
[59] Op. cit. Footnote #26, Rubenstein.
[60] John Muir. *The Mountains of California*. First published in 1894.

A 2013 study in the United Kingdom explored the relationship between momentary subjective wellbeing and individuals' immediate environment.[61] The study authors created and applied an innovative tool for collecting data and analyzing the relationship between a participant's physical setting and how contented he or she felt in that moment. They developed an app for smartphones that signaled participants at random moments and presented a brief questionnaire while using the phone's Global Positioning System (GPS) to pinpoint the location of the study participant. More than 20,000 participants provided over one million responses. On the whole, study participants were "significantly and substantially happier outdoors in all green or natural habitat types than they [were] in urban environments."

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

The 2014 national survey[62] mentioned above of Americans found that most of them at least superficially recognized the value of non-developed open spaces for their emotional well-being.

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

A majority of Americans also indicated to pollsters that they want to have easy access to natural areas near where they live.

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

[61] MacKerron, George and Susan Mourato. 2013. Happiness is greater in natural environments. *Global Environmental Change*. Elsevier. 23(5): 992-1000. Available online at: https://www.sciencedirect.com/science/article/abs/pii/S0959378013000575.
[62] Op. cit. Footnote #18. Pulse Opinion Research, 2014; Appendix F to this report.

Oregonians are famously avid outdoorsmen and women, participating in a wide variety of outdoor pursuits in the state. Hunting, fishing, camping, boating, rafting, kayaking, hiking, backpacking, mountaineering, wildlife observation and photography are all very popular in the state. Oregon Outdoors, established in 2017, is a coalition of non-governmental conservation groups, outdoor recreation businesses, recreation organizations, and concerned Oregonians committed to preserving Oregon's outdoor assets for posterity.[63] Its mission is "to harness the shared interests and influence of outdoor recreation businesses, conservation groups and recreation organizations to preserve and expand Oregon's outdoor assets for future generations." The group seeks to ensure that outdoor recreation is recognized and sustained as an integral part of Oregon's identity, culture, and sustainable economy.

As the state becomes more populated and open space diminishes due to the development and urbanization needed to accommodate that population growth, opportunities for outdoor recreation will decline and the "user experience," that is, how enjoyable the outdoor experience is for participants, will decrease. Overcrowding, congestion, and increased competition for space and resources will increase.

Hiking in the Three Sisters Wilderness Area of Central Oregon

[63] Oregon Outdoors website. https://www.oregonoutdoors.org/.

Hells Canyon on the Snake River in Eastern Oregon

2.6 Why Americans (and Oregonians) Still Dislike Sprawl

While not garnering the media attention it once did in the 1990s and early 2000s, 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.[64] The 46 measures passed nationally 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, New Mexico Land Conservancy, North Florida Land Trust, and Coalition of Oregon Land Trusts (COLT) continue to garner substantial public support. In the November 2016 election alone, 25 land conservation ballot measures were voted on in 10

[64] Land Trust Alliance. 2012. Voters Approve 81% of Land Conservation Ballot Measures.

different states.[65] In Oregon, COLT represents 25 NGOs dedicated to protecting and defending wildlife, wild places, working farms and forests.[66]

Urban sprawl also imposes significant economic and financial costs on the public. These costs are often hidden in the form of taxpayer subsidies to build new roads, water supply systems, sewage collection and treatment systems, and schools to accommodate runaway growth.[67]

In short, Americans and Oregonians still value our rural lands and natural habitats (and ready access to them); oppose 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 2014 and 2019 polling[68] found that sizeable majorities of Americans in general and Oregonians in particular feel strongly about the need to protect farmland and natural habitats for themselves, for their fellow Americans, Oregonians, posterity, and for the nation's wildlife. Large majorities of Americans and Oregonians 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.

3. 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.

3.1 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.

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[65] Trust for Public Land. 2016 conservation ballot measures.
[66] Coalition of Oregon Land Trusts, at: https://oregonlandtrusts.org/.
[67] Eben Fodor. 1999. *Better Not Bigger: How to Take Control of Urban Growth and Improve Your Community*. New Catalyst Books; Eben Fodor. 2012; Eben Fodor. 2012. Why "Smart Growth" Won't Save Us. Updated December 2012. Available online at: http://www.fodorandassociates.com/Reports/Why_Smart_Growth_Won%27t_Save_Us.pdf .
[68] Op. cit. Footnotes #18 and #19, Pulse Opinion Research. Also see Appendices E and F.

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

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

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

Defining sprawl by the Census standards has some limitations that are discussed in Appendix D. But the UA delineations, coupled with the NRI surveys, are unequalled as uniform, quantitative, longitudinal measures of rural urbanization by cities and towns in all regions of the country.

3.2 Our Two Main Data Sources

Urbanized Area data from the 2000-2010 Census and Developed Land data from the 2002-2012 National Resources Inventories served as our main data sources for our current study of sprawl in Oregon. While the Census data pertain to a discrete list of designated cities, the NRI data furnish a portrait that also includes development in places outside of the boundaries of the Census Bureau's UAs. Therefore, we were able to assess and include traditional sprawl and development within Oregon 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 2012, Small Built-up Areas comprised 7.3 million acres or about six percent of the total of 114.1 million acres of Developed Land in the contiguous United States.

This study quantifies the amount of sprawl in Oregon over the most recent periods for which the most comprehensive government data are available: 2000-2010 for UAs and 2002-2015 for Developed Lands. Urbanized Area data are calculated only once every 10 years. Thus, our study can assess the march of sprawl up to 2015 using the NRI's "Developed Land" dataset.

Available NRI Developed Land estimates span an uninterrupted 33-year period from 1982-2015 in six 5-year intervals (1982-1987, 1987-1992, 1992-1997, 1997-2002, 2002-2007, 2007-

2012) and one 3-year interval (2012-2015). 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 33-year time period in its entirety. Therefore, we are able to see how sprawl in Oregon has consistently impacted areas outside of the Census' Urbanized Areas over the last 33 years.

3.2.1 Census Bureau's Urbanized Areas

The U.S. Census Bureau classifies all geographic areas of the United States as either urban or rural. Urban places are those characterized by densely populated and developed land above a minimum population threshold; they include residential, commercial, industrial and other non-residential urban land uses.[69]

The Census Bureau has been making these classifications for a long time: it first defined urban places in reports following the 1880 and 1890 censuses. It adopted the current minimum population threshold for urban areas of 2,500 a century ago back in the 1910 Census; any incorporated place that contained at least 2,500 people within its boundaries was designated as urban. All territories outside of these urban places, regardless of their population densities, were considered rural.[70]

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

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

According to the Census Bureau, in the 2010 Census, an urban area consists of a "densely settled core of census tracts and/or census blocks that meet minimum population density requirements, along with adjacent territory containing non-residential urban land uses as well

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

as territory with low population density included to link outlying densely settled territory with the densely settled core."[71] In essence, UAs represent America's "urban footprint."[72]

For the 2010 Census, the Bureau utilized Geographic Information System (GIS) software from the world's largest developer and supplier of GIS software, the Environmental Systems Research Institute, Inc. (ESRI) to delineate the nation's urban areas.[73]

The initial delineation of an urbanized core includes census tracts or blocks with a population density of 1000 people per square mile (ppsm). Adjacent tracts or blocks with a density of 500 ppsm are then added iteratively. Impervious qualifying blocks are also added iteratively to the UA. These are areas of impervious ground surface (covered with pavement or structures) that support non-residential urban land use such as commercial or industrial; they have low population density because they are non-residential, but they are functionally part of the urban landscape. The Bureau uses an ESRI tool called ArcGIS Spatial Analyst to analyze the Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) 2006 impervious 30-meter raster dataset. Holes or enclaves in the polygon less than five square miles in area that are completely surrounded by qualifying land are filled in, and counted as part of the UA.[74]

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

A jump is a connection from one urban area core to other qualifying urban territory along a road connection between 0.5 mile and 2.5 miles in length; only one jump may be made along any given road connection. The jump concept has been part of the UA delineation process since the 1950 Census. It provides a means for recognizing that urbanization may be offset by intervening areas that have not yet developed. The Census Bureau changed the maximum jump distance criterion from 1.5 miles to 2.5 miles between the 1990 and 2000 censuses.[75]

[71] See note 29.
[72] U.S. Census Bureau. 2011. The Use of ESRI Software in the Delineation of Urban Areas for the 2010 Census. PowerPoint presentation at the ESRI International User Conference July 12th, 2011.
[73] Ibid.
[74] Ibid.
[75] Ibid.

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

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

Between 2000 and 2010, the country's urban population grew by 12.1%, in comparison with total U.S. population growth of 9.7% during the same period. In other words, America's urban areas grew at a faster pace than the country as a whole, continuing a demographic trend – a relative shift or migration of the population from rural to urban areas – that has been underway for more than a century. This trend is evident around the entire world, including Oregon. In Oregon, between 2000 and 2010, the population of the state's 10 UAs grew by 17%, compared to 12% for the state as a whole, meaning that that there was a relative shift of population from rural to urban areas as well as rapid population growth overall; simply put, rural areas didn't grow as fast as urban areas, and some rural areas actually shrank in population.

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

The National Resources Inventory (NRI) is based on rigorous scientific and survey protocols. The U.S. Department of Agriculture's NRCS began developing the NRI in 1977 in response to several Congressional mandates. The first NRI published in 1982 used most of the survey methodology and protocols utilized by earlier inventories. However, the scope and sample size of the 1982 NRI were expanded to meet the demands of the Soil and Water Resources Conservation Act (RCA) of 1977, as well as to better address emerging issues like the permanent loss of agricultural lands to nonagricultural uses, such as transportation, industry, commercial and residential land uses.[76]

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

[76] 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.

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.[77]

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.[78]

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.[79]

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

[77] Ibid.
[78] Ibid.
[79] Ibid.

NRI survey data. The RSLs are now staffed with permanent employees whose full-time job is NRI data collection and processing.[80]

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.[81]

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

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

3.3 Population Growth

A city or state's population grows based on personal behavior – births and in-migration – and on local and national governmental actions and policies. Looking more closely, the net increase (or decrease) in population in any given time period (e.g., one year, one decade) is

[80] Ibid.
[81] Ibid.

due to the number of births minus the number of deaths plus the number of in-migrants minus the number of out-migrants.

Nowadays, rapid growth in an 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 incentives that encourage people to move into a particular urban area. These include (a) aggressive campaigns to persuade industries and corporations to move their factories, offices, headquarters, and jobs from another location, (b) 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 (c) general public relations that increase the attractiveness and "business friendliness" of a city to outsiders and the business community. Even without trying, a city can attract new residents just by maintaining amenities, good schools, low crime rates, and a high quality of life, especially if the nation's population is growing significantly, as continues to be the case today.

3.3.1 Population Growth in Oregon's Urbanized Areas

Table 7 shows population growth in Oregon's 10 Urbanized Areas from 2000 to 2010. On average, these UAs grew by 17 percent in ten years, at an annual compound (exponential) rate of 1.6%.

Table 7. Population Growth in Oregon Urbanized Areas from 2000 to 2010

Urbanized Area (largest to smallest)	Population in 2000	Population in 2010	Growth	% growth
Portland, OR--WA	1,583,138	1,849,898	266,760	17%
Eugene, OR	224,049	247,421	23,372	10%
Salem, OR	207,229	236,632	29,403	14%
Medford, OR	128,780	154,081	25,301	20%
Bend, OR	57,525	83,794	26,269	46%
Longview, WA--OR	60,443	63,952	3,509	6%
Corvallis, OR	58,229	62,433	4,204	7%
Albany, OR	42,193	56,997	14,804	35%
Walla Walla, WA--OR	43,366	55,805	12,439	29%
Grants Pass, OR	43,811	50,520	6,709	15%
All Oregon UAs	**2,448,763**	**2,861,533**	412,770	17%

3.3.2 Population Growth in Oregon Counties

Figure 4 depicts Oregon's 36 counties and **Table 8** shows the population of those counties in 1982, 2002, and 2015. On average, these 36 counties grew by 51 percent during these 33 years, at an annual compound (exponential) rate of 1.25%. Yet during these three-plus decades, even as the state population as a whole grew significantly, all counties did not grow equally. Far from it. Counties on the periphery of existing urbanized areas tended to have the highest growth rates, counties in established cities middle growth rates, and rural counties the lowest growth rates, with a handful of rural counties actually declining in population.

Figure 4. Oregon Counties

Table 8. Population Growth in Oregon Counties from 1982 to 2015

County	Population in 1982	Population in 2002	Population in 2015	Growth, 1982-2015	% growth, 1982-2015
Baker	16,376	16,618	16,425	49	0%
Benton	69,463	79,542	90,005	20,542	30%
Clackamas	247,803	349,445	397,385	149,582	60%
Clatsop	32,545	35,884	37,750	5,205	16%
Columbia	36,170	44,808	50,390	14,220	39%
Coos	61,774	62,671	62,990	1,216	2%

County	Population in 1982	Population in 2002	Population in 2015	Growth, 1982-2015	% growth, 1982-2015
Crook	12	18,536	21,085	8,138	63%
Curry	17,411	21,557	22,470	5,059	29%
Deschutes	63,031	122,794	170,740	107,709	171%
Douglas	91,741	101,933	109,910	18,169	20%
Gilliam	2,002	1,896	1,975	-27	-1%
Grant	7,977	7,732	7,430	-547	-7%
Harney	7,468	7,521	7,295	-173	-2%
Hood River	16,082	20,590	24,245	8,163	51%
Jackson	133,843	186,446	210,975	77,132	58%
Jefferson	12,304	19,556	22,445	10,141	82%
Josephine	58,147	77,411	83,720	25,573	44%
Klamath	59,038	64,533	67,110	8,072	14%
Lake	7,782	7,534	8,010	228	3%
Lane	272,348	329,046	362,150	89,802	33%
Lincoln	36,365	45,069	47,225	10,860	30%
Linn	89,746	105,441	120,860	31,114	35%
Malheur	27,641	31,863	31,480	3,839	14%
Marion	209,186	289,757	329,770	120,584	58%
Morrow	7,516	10,877	11,630	4,114	55%
Multnomah	565,190	671,986	777,490	212,300	38%
Polk	45,665	65,132	78,570	32,905	72%
Sherman	2,156	1,834	1,790	-366	-17%
Tillamook	21,653	24,359	25,690	4,037	19%
Umatilla	60,233	71,859	79,155	18,922	31%

County	Population in 1982	Population in 2002	Population in 2015	Growth, 1982-2015	% growth, 1982-2015
Union	24,540	24,669	26,625	2,085	8%
Wallowa	7,412	7,129	7,100	-312	-4%
Wasco	22,769	24,001	26,370	3,601	16%
Washington	259,723	462,638	570,510	310,787	120%
Wheeler	1,472	1,511	1,445	-27	-2%
Yamhill	57,411	88,410	103,630	46,219	81%
All Oregon Counties	**2,664,930**	**3,502,588**	**4,013,845**	**1,348,915**	**51%**

Indeed, six counties of the 36 in Oregon (17 percent) lost population between 1982 and 2015. These population declines did not happen as a result of the death rate exceeding the birth rate, but as a result of out-migration toward jobs and greater economic, social, and cultural opportunities elsewhere. Out-migration from these rural counties tended to be towards larger towns and cities, rather than out of the state altogether; they form part of the historic, long-term process of urbanization that began in England with industrialization in the late 1700s, came to America in the 1800s, and continues around the world to this day and well into the future. As of 2014, 54 percent of the world's population resided in urban areas, a percentage that is increasing; by 2050, two-thirds (66%) of the world's population is projected to be urban.[82]

3.3.3 Sources of Population Growth in Oregon

Sixty-two percent of Oregon's recent population growth (from 2000 to 2015) is due directly and indirectly to migration: both foreign and domestic or internal. Approximately 30 percent of Oregon's recent population growth is due directly and indirectly to immigration from foreign countries, while another 32 percent is due to internal migration from other states, in particular California (**Figures 5 and 6**).[83] Californians have been fleeing their state

[82] United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

[83] Portland State University, College of Urban & Public Affairs: Population Research Center, "Population Estimates and Reports: Certified Population Estimates, July 1, 2018." The PSU estimates are based upon U.S. Census Bureau data. Oregon's population change is measured by natural increase (births minus deaths) and net migration (number of people who moved into the state minus those who moved out of the state). The Census Bureau also measures the increase in the foreign-born population, as well as births to

in droves for the past three decades (an exodus of more than 13 million since 1990), driven away in good part because of high housing costs, crime levels, and related issues, which are themselves symptoms of the state's gross overpopulation (it has now reached 40 million).

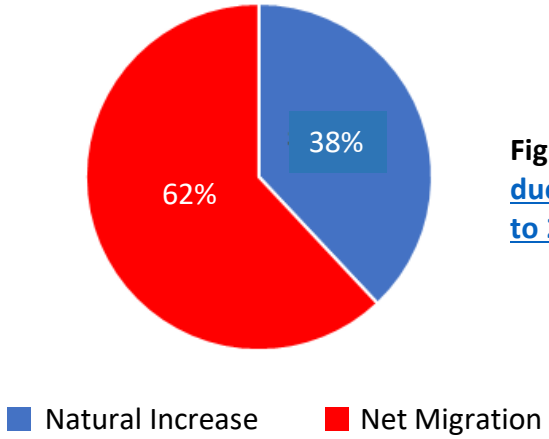
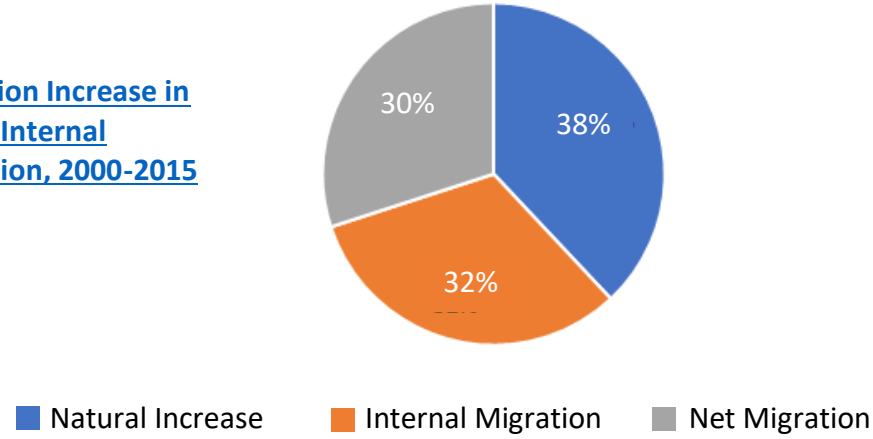


Figure 5. Percentages of Population Increase in Oregon due to Natural Increase and Net Migration from 2000 to 2015

Figure 6. Percentages of Population Increase in Oregon due to Natural Increase, Internal Migration, and Foreign Immigration, 2000-2015



3.4 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. See **Table 10** for the per capita numbers for the Oregon Urbanized Areas and Appendices B and C for how the statistic is calculated. When Census Bureau data show that per capita land consumption in Portland is 0.18 acre, it means that almost one-fifth of an acre is used to provide the average

foreign-born mothers. According to U.S. Census Bureau data, the increase in the total population of Oregon due to the increase in the foreign-born population was 19.1%. If children living in the states in 2015 who were born in 2000 or later and who have a foreign-born mother are included, immigration accounted for 29.8% of the total increase in those states.

Portland resident with space for housing, work, retail, transportation, education, religious assembly, government, recreation, utilities, and all other urban needs.

Table 9 shows the variation of per capita land use among Oregon's 10 Urbanized Areas and change from 2000 to 2010. The average Portland resident "occupied" almost one fifth (0.18) of an acre of developed land in 2010, while on the other extreme, the average resident of the Grants Pass UA uses almost twice as much, more than one-third of an acre (0.34). In general, around the country, larger cities like Portland have higher population densities, which should come as no surprise.

Overall, per capita land consumption in Oregon UAs dipped from 0.22 acre in 2000 to 0.21 acre in 2010, a decrease of four percent, which is good news for efforts to combat sprawl if not for urban residents' sense of elbow room. Per capita land consumption fell in seven of the ten Oregon UAs.

Table 9. Per Capita Land Consumption in Oregon Urbanized Areas – 2000 and 2010

Urbanized Area	Per Capita Land Consumption – 2000 (acre)	Per Capita Land Consumption - 2010 (acre)	% Change in Per Capita Land Consumption, 2000-2010
Portland, OR--WA	0.19	0.18	-5%
Eugene, OR	0.20	0.22	15%
Salem, OR	0.21	0.21	-4%
Medford, OR	0.29	0.27	-8%
Bend, OR	0.40	0.30	-25%
Longview, WA--OR	0.28	0.33	16%
Corvallis, OR	0.32	0.22	-32%
Albany, OR	0.25	0.27	9%
Walla Walla, WA--OR	0.34	0.32	-7%
Grants Pass, OR	0.37	0.34	-7%
All Oregon UAs	**0.22**	**0.21**	**-4%**

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 urban areas. Census data on the nation's Urbanized Areas allow us to track the change in per capita land consumption from decade to decade.

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

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

The fact that average per capita land consumption decreased by four percent between 2000 and 2010 reflects a modicum of cumulative progress in Oregon's efforts to reduce the rate of sprawl and the loss of rural lands by increasing population density in already developed as well as newly developed areas.

Table 10 compares growth in population to change in per capita land consumption in Oregon UAs from 2000 to 2010. On average, these UAs grew in population by 17 percent, while their per capita land consumption actually decreased by four percent. In other words, the overall decrease in per capita land consumption was more than offset by population growth: the percentage increase of which was more than four times the percentage decrease in per capita land consumption. As we

will see in the next section, this imbalance or disparity has major implications for the amount of sprawl that resulted.

Table 10. Population Growth vs. Change in Per Capita Land Consumption Oregon Urbanized Areas, 2000-2010

Urbanized Area	% POPULATION GROWTH, 2000-2010	% CHANGE IN PER CAPITA LAND CONSUMPTION, 2000-2010
Portland, OR--WA	17%	-5%
Eugene, OR	10%	15%
Salem, OR	14%	-4%
Medford, OR	20%	-8%
Bend, OR	46%	-25%
Longview, WA--OR	6%	16%
Corvallis, OR	7%	-32%
Albany, OR	35%	9%
Walla Walla, WA--OR	29%	-7%
Grants Pass, OR	15%	-7%
All Oregon UAs	**17%**	**-4%**

Ta**ble 11** shows the variation of per capita land use among Oregon's 36 counties and change from 1982 to 2015. The average resident of the high-density, developed part of Multnomah County (which includes Portland) "consumes" just 0.12 of an acre of developed land, while at the other extreme, the average resident of rural Wheeler County consumes many times more at 3.81 acres. In general, in keeping with land use patterns observed around the country, residents of larger cities have lower per capita developed land consumption than residents of rural areas. However, this raw statistic can be slightly misleading. It isn't just that rural residents tend to have much larger yards or longer driveways, but that smaller-population and lower-population-density rural areas contain utility, economic, transportation, and other infrastructure (all counting as "developed land") that supports populations in urban centers.

Overall, per capita land consumption in Oregon counties declined slightly from 0.37 acre in 1982 to 0.35 acre in 2015, a decrease of five percent.

Table 11. Per Capita Land Consumption in Oregon Counties from 1982 and 2015

County	Per Capita Land Consumption – 1982 (acre)	Per Capita Land Consumption - 2015 (acre)	% Change in Per Capita Land Consumption, 1982-2015
Baker	0.90	0.99	10%
Benton	0.35	0.33	-4%
Clackamas	0.29	0.28	-2%
Clatsop	0.57	0.59	4%
Columbia	0.39	0.40	3%
Coos	0.45	0.64	43%
Crook	0.83	0.73	-12%
Curry	0.87	0.93	8%
Deschutes	0.37	0.35	-7%
Douglas	0.62	0.64	3%
Gilliam	3.45	5.82	69%
Grant	1.22	1.71	41%
Harney	1.97	2.34	19%
Hood River	0.55	0.48	-13%
Jackson	0.53	0.44	-16%
Jefferson	1.03	1.03	0%
Josephine	0.44	0.56	27%
Klamath	0.46	0.53	16%
Lake	2.00	2.36	18%
Lane	0.41	0.39	-4%
Lincoln	0.62	0.63	3%
Linn	0.45	0.49	10%
Malheur	0.62	0.75	22%
Marion	0.28	0.27	-3%

County	Per Capita Land Consumption – 1982 (acre)	Per Capita Land Consumption - 2015 (acre)	% Change in Per Capita Land Consumption, 1982-2015
Morrow	1.17	1.03	-12%
Multnomah	0.12	0.12	-5%
Polk	0.38	0.34	-11%
Sherman	1.67	2.07	24%
Tillamook	0.84	1.03	23%
Umatilla	0.36	0.46	28%
Union	0.55	0.69	25%
Wallowa	1.42	1.76	24%
Wasco	0.83	0.92	11%
Washington	0.20	0.16	-23%
Wheeler	2.65	3.81	44%
Yamhill	0.30	0.25	-19%
All Oregon Counties	**0.37**	**0.35**	**-5%**

Table 12 compares growth in population to change in per capita land consumption in Oregon counties from 1982 to 2015. On average, these counties grew in population by 51 percent in these 33 years, while their per capita land consumption actually decreased by five percent. In other words, as with UAs, the overall decrease in per capita land consumption was more than offset by population growth. the percentage increase of which was more than 10 times the percentage decrease in per capita land consumption. As we will see in the next section, this imbalance or disparity has major implications on the amount of sprawl that resulted.

Table 12. Population Growth vs. Change in Per Capita Land Consumption in Oregon Counties, 1982-2015

County	% POPULATION GROWTH, 1982-2015	% CHANGE IN PER CAPITA LAND CONSUMPTION, 1982-2015
Baker	0%	10%
Benton	30%	-4%
Clackamas	60%	-2%
Clatsop	16%	4%
Columbia	39%	3%
Coos	2%	43%
Crook	63%	-12%
Curry	29%	8%
Deschutes	171%	-7%
Douglas	20%	3%
Gilliam	-1%	69%
Grant	-7%	41%
Harney	-2%	19%
Hood River	51%	-13%
Jackson	58%	-16%
Jefferson	82%	0%
Josephine	44%	27%
Klamath	14%	16%
Lake	3%	18%
Lane	33%	-4%
Lincoln	30%	3%
Linn	35%	10%
Malheur	14%	22%

County	% POPULATION GROWTH, 1982-2015	% CHANGE IN PER CAPITA LAND CONSUMPTION, 1982-2015
Marion	58%	-3%
Morrow	55%	-12%
Multnomah	38%	-5%
Polk	72%	-11%
Sherman	-17%	24%
Tillamook	19%	23%
Umatilla	31%	28%
Union	8%	25%
Wallowa	-4%	24%
Wasco	16%	11%
Washington	120%	-23%
Wheeler	-2%	44%
Yamhill	81%	-19%
All Oregon Counties	**51%**	**-5%**

3.5 Measuring Overall Sprawl

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

With the Census Bureau Urbanized Areas, the Overall Sprawl was measured by calculating the change in the land area of each of the UAs from the 2000 Census to the 2010 Census.

Meanwhile, the NRI provided estimates on how many acres of rural land had been converted into developed land in 5-year increments within their 33-year time span.

Wild horses near Warm Springs, Oregon

Urban Growth Boundary on the edge of Portland

4. FINDINGS

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

4.1 Oregon Urbanized Areas and Developed Areas

4.1.1 Per Capita Sprawl and Overall Sprawl

Many respected environmental organizations and urban planners contend that implementing Smart Growth, New Urbanism, and LEED[84] building strategies into our new and existing cities is the primary way to rein in sprawl in our cities. However, this is based on the premise that it is only or primarily our land-use choices that cause sprawl in Oregon. 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 Areas. Oregon is no exception.

By comparing the percentage change of per capita land consumption with the percentage growth of Overall Sprawl in the 10 Urbanized Areas in Oregon from 2000 to 2010 in **Figure 7** and **Table 13**, we see that the Per Capita Sprawl percentage was actually negative. But compared with that accomplishment, Overall Sprawl increased by 12 percent.

This is not to disparage Smart Growth, New Urbanism, and the LEED program, but to recognize their limitations. These multi-faceted, multi-jurisdictional approaches have indeed slowed the pace at which sprawl is converting the countryside into pavement and buildings over the last decade. Given incessant population growth, however, they were capable only of somewhat slowing sprawl, not coming close to stopping it.

[84] 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

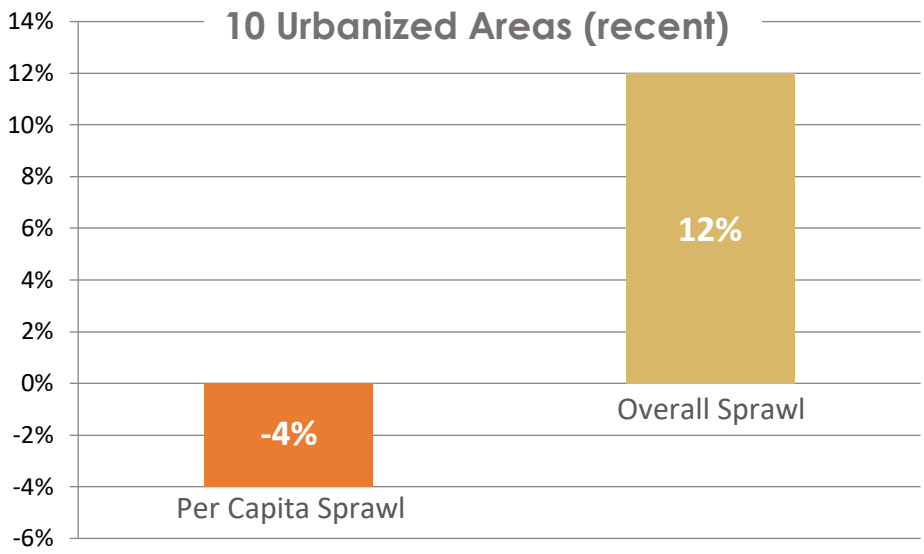


Figure 7. Per Capita Sprawl vs. Overall Sprawl in Oregon UAs, 2000-2010

Note**:** Per Capita Sprawl is % growth (change) in per capita land consumption and Overall Sprawl is % growth in total urbanized land area.

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

Table 13. Per Capita Sprawl vs. Overall Sprawl Oregon Urbanized Areas from 2000 to 2010

Urbanized Area	% Change in Per Capita Land Consumption, 2000-2010 (PER CAPITA SPRAWL)	% Change in Overall Land Consumption, 2000-2010 (OVERALL SPRAWL)
Portland, OR--WA	-5%	11%
Eugene, OR	15%	27%
Salem, OR	-4%	10%
Medford, OR	-8%	10%
Bend, OR	-25%	3%
Longview, WA--OR	16%	6%
Corvallis, OR***	-32%	-27%
Albany, OR	9%	48%

Urbanized Area	% Change in Per Capita Land Consumption, 2000-2010 (PER CAPITA SPRAWL)	% Change in Overall Land Consumption, 2000-2010 (OVERALL SPRAWL)
Walla Walla, WA--OR	-7%	20%
Grants Pass, OR	-7%	7%
Weighted Average (Mean)	**-4%**	**12%**

***See Appendix D.

Turning now to Oregon's counties, we see much the same phenomenon: average per capita land consumption actually **declined** by five percent between 1982 to 2015, meaning that declining population density drove little or none of Oregon's aggregate sprawl, which was 43 percent over this period (**Table 14**). For declining density to have been a major driver of urban sprawl in the state over these years, the opposite would have occurred, namely, average per capita sprawl (per capita land consumption) would have increased. This did not happen when the counties are aggregated into one state average. However, if we look at each county individually and then sum them, as we do in following sections, we will see that a slightly different picture emerges of the degree to which each of the two factors (population growth and growth in per capita land consumption) is responsible for sprawl in the state.

Table 14. Per Capita Sprawl vs. Overall Sprawl Oregon Counties – 1982 to 2015

County	% Change in Per Capita Land Consumption, 1982-2015 (PER CAPITA SPRAWL)	% Change in Overall Land Consumption, 1982-2015 (OVERALL SPRAWL)
Baker	10%	10%
Benton	-4%	24%
Clackamas	-2%	57%
Clatsop	4%	21%
Columbia	3%	43%
Coos	43%	45%

County	% Change in Per Capita Land Consumption, 1982-2015 (PER CAPITA SPRAWL)	% Change in Overall Land Consumption, 1982-2015 (OVERALL SPRAWL)
Crook	-12%	43%
Curry	8%	39%
Deschutes	-7%	152%
Douglas	3%	24%
Gilliam	69%	67%
Grant	41%	31%
Harney	19%	16%
Hood River	-13%	31%
Jackson	-16%	32%
Jefferson	0%	83%
Josephine	27%	83%
Klamath	16%	32%
Lake	18%	21%
Lane	-4%	28%
Lincoln	3%	33%
Linn	10%	48%
Malheur	22%	39%
Marion	-3%	53%
Morrow	-12%	36%
Multnomah	-5%	31%
Polk	-11%	52%
Sherman	24%	3%
Tillamook	23%	46%
Umatilla	28%	68%

County	% Change in Per Capita Land Consumption, 1982-2015 (PER CAPITA SPRAWL)	% Change in Overall Land Consumption, 1982-2015 (OVERALL SPRAWL)
Union	25%	36%
Wallowa	24%	19%
Wasco	11%	28%
Washington	-23%	69%
Wheeler	44%	41%
Yamhill	-19%	46%
All Oregon Counties	**-5%**	**43%**

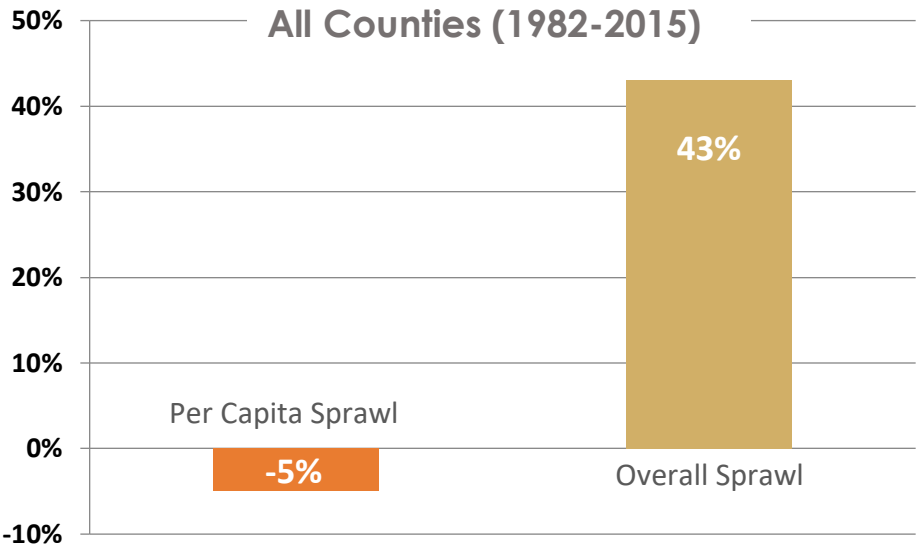


Figure 8. [Per Capita Sprawl vs. Overall Sprawl in Oregon Counties, 1982-2015]
Note**:** Per Capita Sprawl is % growth (change) in per capita land consumption and Overall Sprawl is % growth in Developed Land area.

Table 15 looks at just the most recent period. Between 2002 and 2015 relatively less sprawl occurred in Oregon's counties as the area of developed land increased by six percent (it would have increased by more than 16 percent if sprawl had taken place at the same vertiginous pace as in the eighties and nineties). But once again, per capita sprawl, at minus eight percent from 2002 to 2015, accounted for little or none of this Overall Sprawl.

Table 15. Per Capita Sprawl vs. Overall Sprawl Oregon Counties – 2002 to 2015

County	% Change in Per Capita Land Consumption, 2002-2015 (PER CAPITA SPRAWL)	% Change in Overall Land Consumption, 2002-2015 (OVERALL SPRAWL)
Baker	3	2
Benton	-10	2
Clackamas	-5	8
Clatsop	-5	0
Columbia	-9	2
Coos	11	12
Crook	-5	8
Curry	-2	2
Deschutes	-18	14
Douglas	-4	4
Gilliam	3	7
Grant	7	2
Harney	9	6
Hood River	-10	5
Jackson	-6	6
Jefferson	2	17
Josephine	-2	6
Klamath	2	6
Lake	3	10
Lane	-6	4
Lincoln	-4	1
Linn	-9	5

County	% Change in Per Capita Land Consumption, 2002-2015 (PER CAPITA SPRAWL)	% Change in Overall Land Consumption, 2002-2015 (OVERALL SPRAWL)
Malheur	9	8
Marion	-8	4
Morrow	0	7
Multnomah	-10	4
Polk	-16	1
Sherman	2	0
Tillamook	7	13
Umatilla	-5	5
Union	-5	2
Wallowa	3	2
Wasco	8	19
Washington	-16	4
Wheeler	51	45
Yamhill	-7	9
All Oregon Counties	**-8%**	**6%**

In more than half (21) of Oregon's 36 counties, per capita land consumption decreased between 2002 and 2015, meaning that population density rose on average on average in those counties. Therefore, per capita sprawl was not a factor driving the increase in developed lands in those counties. Any sprawl that took place in those counties was due to population growth.

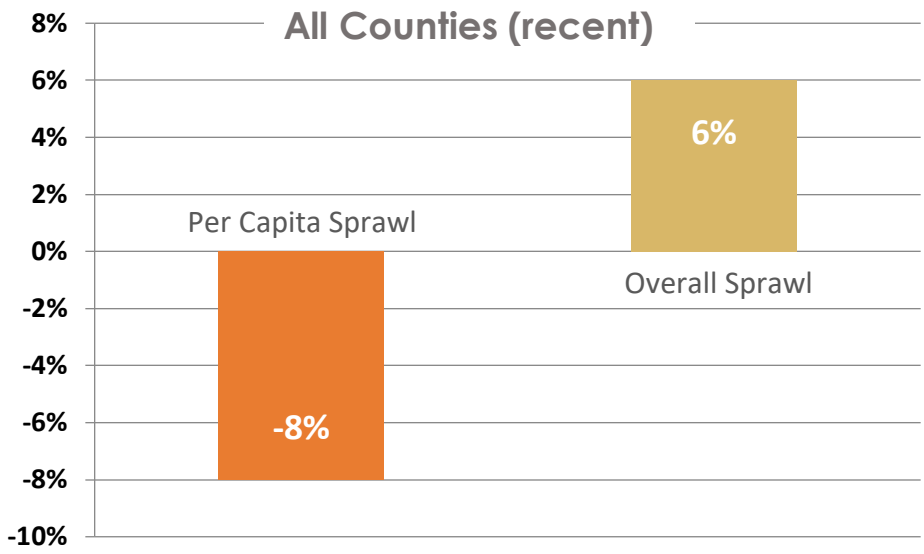


Figure 9. **Per Capita Sprawl vs. Overall Sprawl in Oregon Counties, 2002-2015**
Note**:** Per Capita Sprawl is % growth (change) in per capita land consumption and Overall Sprawl is % growth in Developed Land area.

4.1.2 Per Capita Sprawl versus Population Growth

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

Figure 10 aggregates the 10 UAs in Oregon and finds that their average population change was 17 percent while their per capita land change was minus four percent. Thus we can see that the rate of population growth was much larger factor than the rate of per capita land consumption change in urban sprawl in Oregon from 2000 to 2010. Indeed, Per Capita Sprawl or growth in per capita land consumption was negative.

Figure 11 makes the same comparison for county Developed Area that **Figure 10** does for Urbanized Areas. Even after just a cursory examination of **Figures 10 and 11,** it should be obvious not only that Per Capita Sprawl cannot account for much of Overall Sprawl, but that for both UAs and between 2000 and 2010 and county Developed Areas between 1982 and 2015, it does not appear to be nearly as significant a factor in generating sprawl as Population Growth is. Subsequent sections will explore this finding further by apportioning responsibility for sprawl in cities and counties between Population Growth and Per Capita Sprawl by using another methodology.

Since our primary concern is the ongoing loss of rural lands – agricultural lands, natural habitats, and other open space – to development and sprawl, it is worth seeing how much of this loss is related to Per Capita Sprawl and how much to Population Growth.

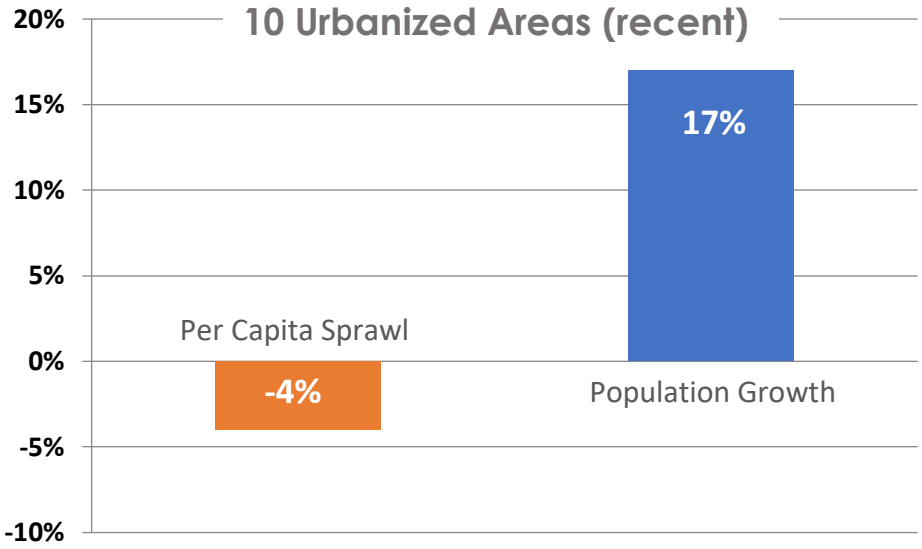


Figure 10. **Per Capita Sprawl vs. Population Growth in 10 Oregon UAs, 2000-2010**
Description**:** When comparing the growth rates of the two factors behind Overall Sprawl we find that population growth was positive (17%) and growth in capita land consumption was negative (-4%) from 2000 to 2010.

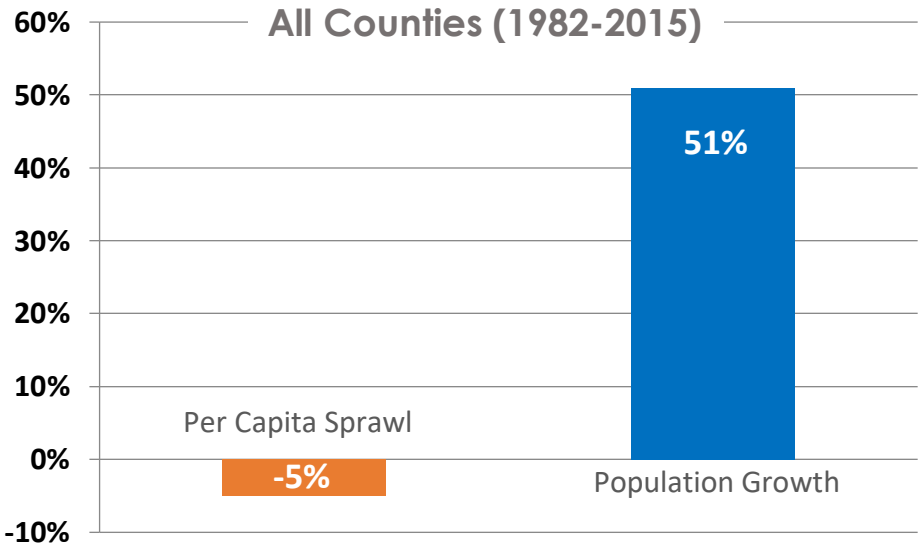


Figure 11. **Per Capita Sprawl vs. Population Growth in 36 Oregon Counties, 1982-2015**
Description**:** When comparing the growth rates of the two factors behind Overall Sprawl we find that population growth was positive (51%) and growth in capita land consumption was negative (-5%) from 1982 to 2015.

The findings of this Oregon study broadly reinforce one of the conclusions of our original sprawl studies nearly 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 have looked into the sprawl phenomenon, we attribute sprawl neither to population growth exclusively nor declining density exclusively, that is, to increasing per capita land consumption.

Figure 12 compares the rates of sprawl when Oregon's ten UAs are divided into three groups based on their rates of population growth from 2000-2010. On average, cities that added more population clearly sprawled over greater area. Strikingly, the two cities that experienced less than 10 percent population growth actually lost land area on average (two percent), but this is a small sample size anomaly, skewed by the fact that the college town of Corvallis (where Oregon State University is located) actually shows up in Census Bureau Urbanized Land data as having lost land area between 2000 and 2010. The five cities whose populations grew between 10 and 20 percent between 2000 and 2010 sprawled on average 13 percent. The three cities whose populations increased by more than 20 percent on sprawled an average of 26 percent.

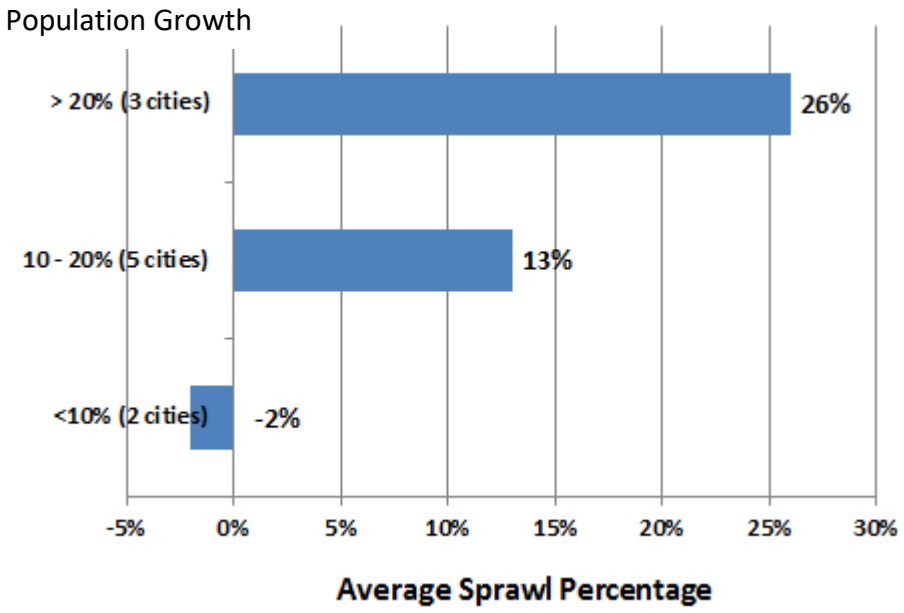


Figure 12. Oregon Cities with More Population Growth (2000-2010) Generated More Sprawl

Examining Oregon's counties the same way in **Figure 13**, we see similar results, showing that a higher average percentage of population growth from 1982 to 2015 resulted overall average percent increase in the area of Developed Land (Overall Sprawl).

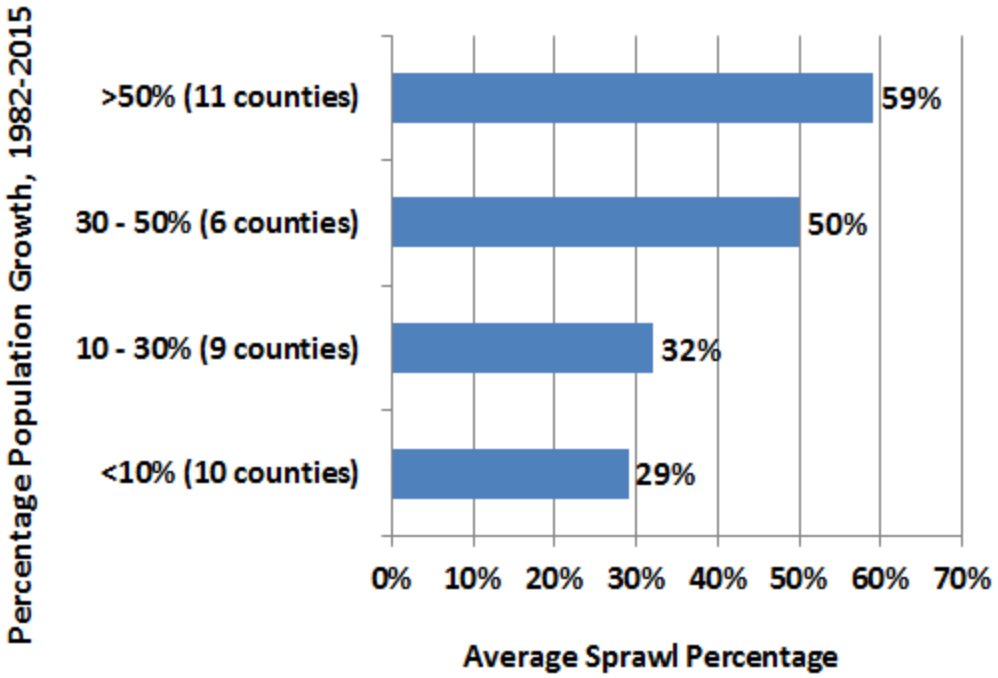


Figure 13. **Oregon Counties with More Population Growth Generated More Sprawl**

Figure 13 demonstrates that even in counties with modest population growth (under ten percent over the 33 years) there tends to be some residual sprawl. The nine counties with 10-30 percent population growth averaged a bit higher sprawl, but those with more than 30 percent population growth had far higher overall sprawl. Per Capita Sprawl, that is, a greater increase in per capita land consumption. However, the Per Capita Sprawl was not sufficiently large to force Overall Sprawl high enough to catch up with the sprawl in those counties with higher population growth.

Figure 14 displays the results of another grouping that once again demonstrates population growth's preeminent role in driving sprawl in Oregon. This figure highlights the amount of population growth in the top five sprawling cities versus the bottom five sprawling cities.

The five cities in Oregon with the most sprawl (18 square miles on average) between 2000 and 2010 had average population growth of 71,928. In contrast, the five cities with the least sprawl (just two square miles on average) averaged 10,626 population growth during the same decade. On average, cities with more population growth sprawl more than cities with less population growth.

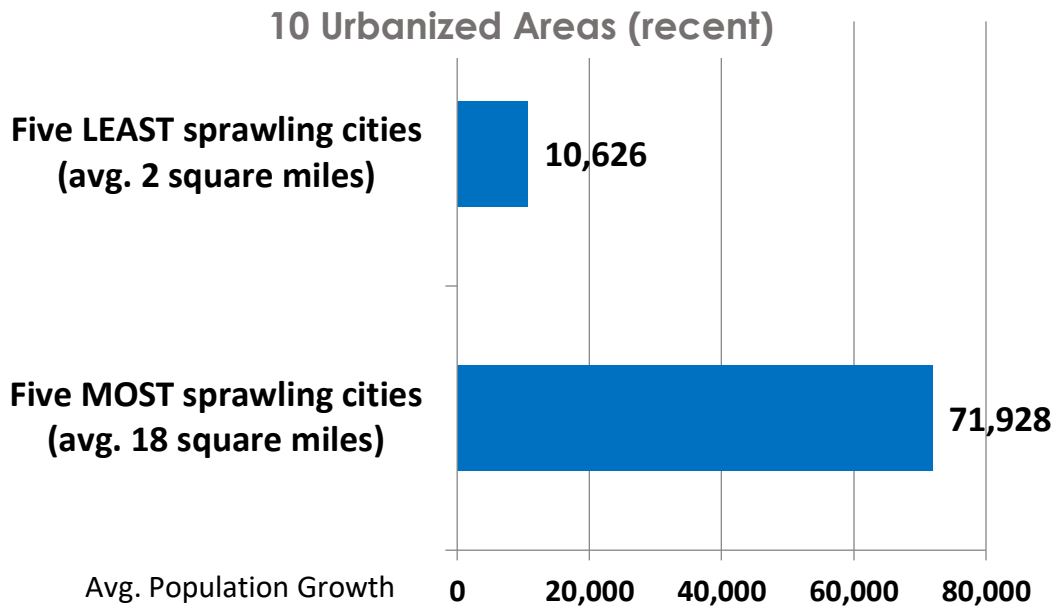


Figure 14. **Average Population Growth in Oregon's Top-Five Sprawling Cities versus Bottom-Five Sprawling Cities, 2000-2010**

Note: Five Oregon Urbanized Areas that sprawled the least between 2000 and 2010, averaging just two square miles of new sprawl, had an average population growth of 10,626. In contrast, those five Oregon UAs that sprawled the most between 2000 and 2010, averaging 18 square miles of new sprawl during the decade, grew by an average (mean) of 71,928 residents during the decade.

Looking at counties in the same way, **Figure 15** compares how much the population grew between 1982 and 2015 in the top ten counties with the most sprawl (increase in Developed Land) and the bottom ten counties with the least amount of sprawl.

The ten Oregon counties that sprawled the least between 1982 and 2015, averaging just four square miles of new sprawl during those 33 years, experienced an average population growth of 1,633. In contrast, those ten Oregon counties that sprawled the most between 1982 and 2015, averaging 43 square miles of new sprawl – ten times as much as the counties that sprawled least – grew by an average (mean) of 114,351 residents, almost 100 times as much as the counties that sprawled the least.

Clearly, there is a connection or correlation between the magnitude of a county's population growth and the amount of land development or sprawl that it undergoes with that added population. Additional people augmenting a place's population have to reside and conduct all the business of a modern life somewhere. In other words, it takes developed or urbanized land to support them, and there are only two ways to build: upward or outward. In other words, increase density, increase area, or some combination of both. Increasing density can reduce the need to increase area (i.e., curtail sprawl), but when population growth is rapid and sustained, typically both an increase in density and an increase in area occur simultaneously.

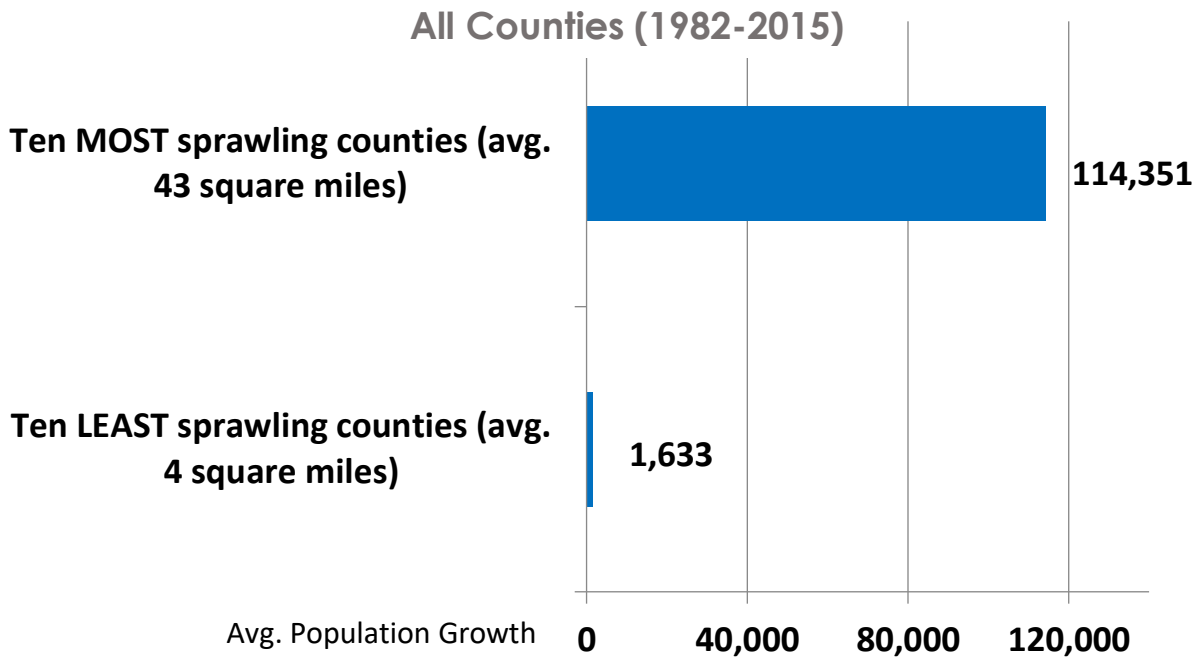


Figure 15. **Average Population Growth in Oregon's Top-Five Sprawling Counties versus Bottom-Five Sprawling Counties, 1982-2015**

Note: Ten Oregon counties that sprawled the least between 1982 and 2015, averaging just four square miles of new sprawl, had an average population growth of 1,633. In contrast, those ten Oregon counties that sprawled the most between 1982 and 2015, averaging 43 square miles of new sprawl, grew by an average (mean) of 114,351 residents.

4.1.3 Relative Weight of Sprawl Factors in Oregon's Urbanized Areas

To better understand and quantify the respective roles of population growth and per capita land consumption in generating Overall Sprawl, we can use a more mathematically sophisticated method that is sometimes used to apportion consumption of natural resources between two or more factors. 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.[85] This method can be applied to virtually any type of resource in which use of

[85] 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,

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 (i.e., open space) is thus the resource in question. As in the case of looking at energy consumption, the issue here is how much of the increased total consumption of rural land (Overall Sprawl) is related to 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 16 applies this method to all 10 Urbanized Areas in Oregon. In the case of Albany, for example, 23 percent of Overall Sprawl was related to, or explained by, increases in per capita land consumption, and 77 percent was related to population growth over the past decade.

Table 16. Sources of Sprawl in Oregon Urbanized Areas, 2000-2010

Urbanized Area	Total Sprawl 2000 to 2010 (square miles)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Portland, OR--WA	50.4	100%	0%
Eugene, OR	18.3	42%	58%
Salem, OR	6.7	100%	0%
Medford, OR	6.0	100%	0%
Bend, OR	3.3	100%	0%
Longview, WA--OR	6.0	28%	72%
Corvallis, OR***	-7.9	N/A	N/A
Albany, OR	7.7	77%	23%
Walla Walla, WA--OR	4.7	100%	0%
Grants Pass, OR	1.8	100%	0%
All Oregon UA's	**97.1**	**91%**	**9%**

***See Appendix D.

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.

Given this apportionment or breakdown, opponents of sprawl in Oregon should know that 91 percent of the sprawl problem in the state's Urbanized Areas is the inability to stabilize the state's population. In contrast, only nine percent of the problem is the inability to stabilize per capita land use within urban development in the state. **Figure 16** displays the relative magnitude of these two factors on a pie chart.

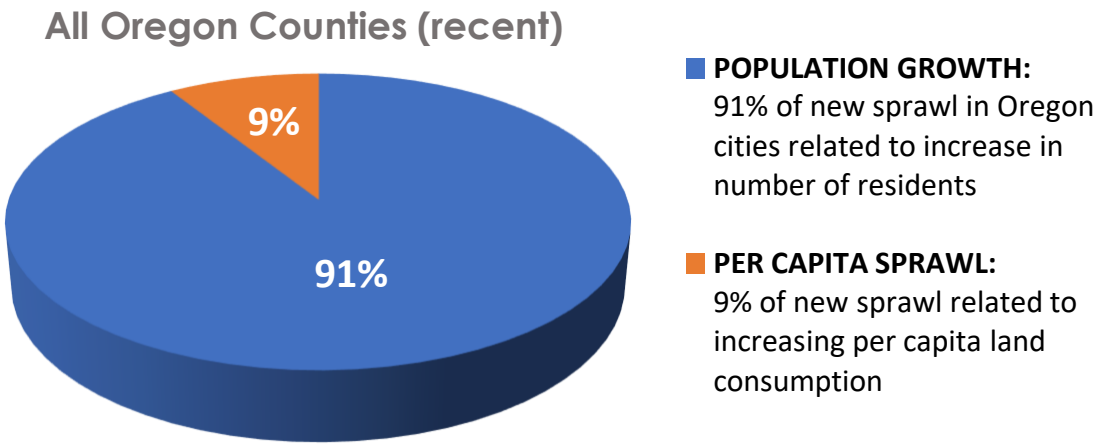


Figure 16. **Percentages of Sprawl Related to Population Growth and Per Capita Sprawl in Oregon's 10 Urbanized Areas**

Source: U.S. Census Bureau, 2000-2010

Description: Approximately nine percent of the sprawl in Oregon's towns and cities was related to increasing per capita land consumption. Approximately 91 percent of the sprawl was related to population growth.

Between 2000 and 2010, the 10 UAs in Oregon sprawled across and consumed 97.1 square additional square miles (62,144 acres) of land in aggregate. **Figure 17** shows that population growth in Oregon's UAs was responsible for almost ten times as much loss of rural land as Per Capita sprawl or rising land consumption per capita: 88.3 square miles vs. 8.8 square miles.

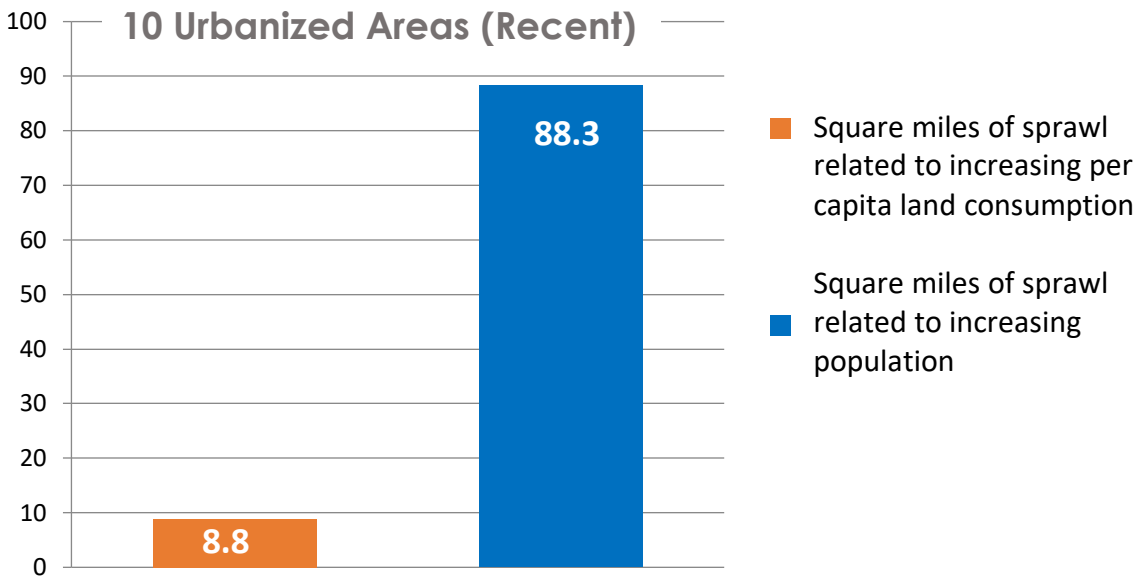


Figure 17. **Rural Land Lost to Per Capita Sprawl vs. Population Growth in 10 Oregon Urbanized Areas, 2000-2010**

4.1.4 Relative Weight of Sprawl Factors in Oregon's Developed Areas

Recall that the Census Bureau's Urbanized Areas and the Natural Resources Conservation Service's Developed Areas in the National Resources Inventory (NRI) are measured in two totally different manners, with different methodologies for collecting data on urban areas versus rural areas, and two completely distinct ways of defining the two land uses. Thus, quantifying sprawl using these two very different databases would not be expected to generate identical results, and indeed, our calculations do not. However, they produce fairly similar results, which is a sign of the robustness of our findings and an indication of their probable veracity.

From 2002 to 2015, a slightly different time frame than the Census Bureau's most recent decade (2000 to 2010), the analysis of NRI Developed Land data for all of Oregon shows that population growth accounted for 81 percent of sprawl in the state (**Table 17** and **Figure 18**). This compares to 91 percent for the 2000-2010 Census Bureau UA delineations. It is not surprising that population density would be higher in growing urban areas than outlying rural parts of the state that are also growing, and this accounts for the difference between the 91% and 81% results.

Increasing per capita land consumption (declining population density or "low-density sprawl") accounted for just 19 percent of Overall Sprawl in Oregon's counties between 2002 and 2015.

Table 17. **Sources of Sprawl in Oregon Counties, 2002-2015**

County	Total Sprawl 2002 to 2015 (square miles)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Baker	0.5	0%	100%
Benton	1.1	100%	0%
Clackamas	13.1	100%	0%
Clatsop	0.2	100%	0%
Columbia	0.6	100%	0%
Coos	6.7	5%	95%
Crook	1.7	100%	0%
Curry	0.8	100%	0%
Deschutes	11.1	100%	0%
Douglas	3.8	100%	0%
Gilliam	1.3	56%	44%
Grant	0.5	0%	100%
Harney	1.4	0%	100%
Hood River	0.9	100%	0%
Jackson	8.7	100%	0%
Jefferson	5.2	90%	0%
Josephine	4.4	100%	0%
Klamath	3.1	68%	32%
Lake	2.7	65%	35%
Lane	8.4	100%	0%
Lincoln	0.3	100%	0%
Linn	4.1	100%	0%
Malheur	2.7	0%	100%
Marion	5.6	100%	0%
Morrow	1.3	97%	3%

County	Total Sprawl 2002 to 2015 (square miles)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Multnomah	5.3	100%	0%
Polk	0.5	100%	0%
Sherman	0.0	N/A	N/A
Tillamook	4.7	44%	66%
Umatilla	2.5	100%	0%
Union	0.6	100%	0%
Wallowa	0.5	0%	100%
Wasco	5.9	55%	45%
Washington	5.2	100%	0%
Wheeler	2.7	0%	100%
Yamhill	3.4	100%	0%
All Oregon Counties	**121.3**	**81%**	**19%**

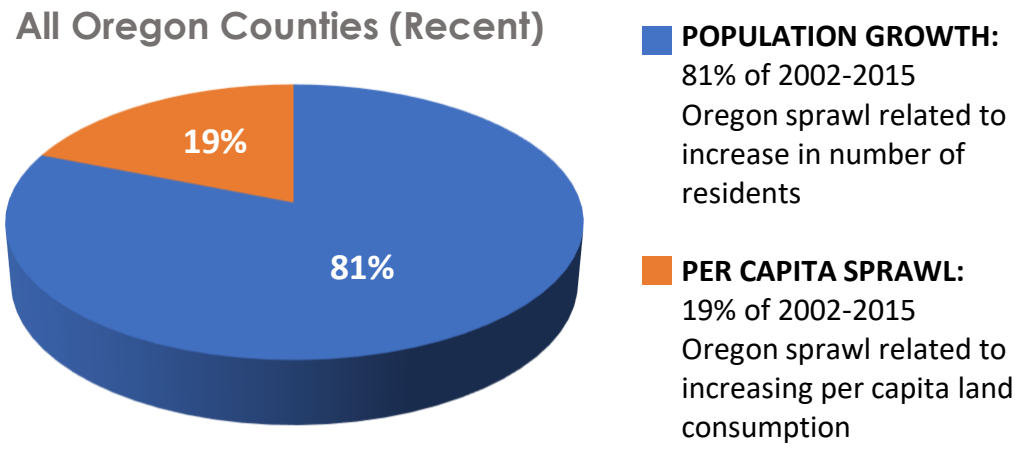


Figure 18. Sprawl Factors (Increasing Population and Increasing Per Capita Land Consumption) in all Oregon Counties, 2002-2015

Between 2002 and 2015, the increase in Developed Land in Oregon's 36 counties sprawled across and consumed 98.5 additional square miles (63,040 acres) of land in aggregate. **Figure**

19 shows that population growth in Oregon's counties was responsible for more than four times as much loss of rural land as rising land consumption per capita. 98.5 square miles vs. 22.8 square miles.

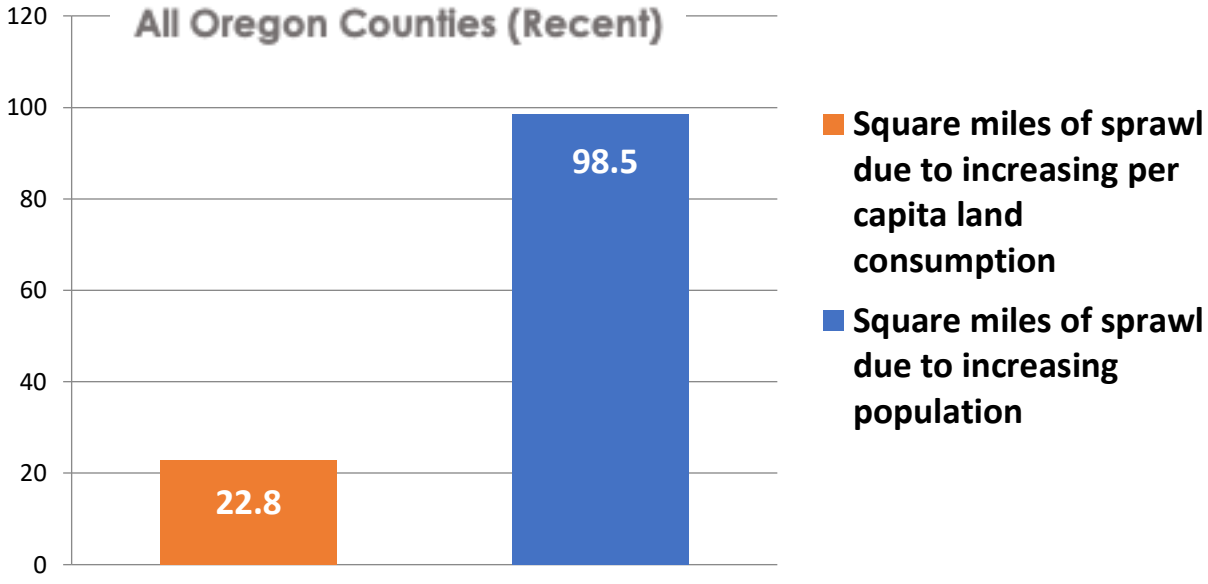


Figure 19. **Rural Land Lost to Per Capita Sprawl vs. Population Growth in Oregon Counties from 2002 to 2015**

Examining the increase in Oregon's Developed Land area from the start of the NRI in 1982 up to the most recent inventory in 2015, we see that a total of approximately 656 square miles (419,800 acres) of sprawl occurred in the state between 1982 and 2015. By 2015, some 2,178 square miles (1,393,800 acres) of Oregon had been developed cumulatively in total.

Of the 656 square miles of rural lands (farmland and natural wildlife habitats) developed and built on between 1982 and 2015, population growth in Oregon accounted for about 82 percent of this sprawl while the increase in per capita land consumption was responsible for the remaining 18 percent.

Table 18 shows the amount of sprawl county by county and how it was apportioned between population growth and Per Capita Sprawl, or increasing per capita land consumption, and **Figure 20** visually portrays these aggregate data.

Table 18. Sources of Sprawl in Oregon Counties, 1982-2015

County	Total Sprawl 1982 to 2015 (square miles)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Baker	2.3	3%	97%
Benton	9.1	100%	0%
Clackamas	63.4	100%	0%
Clatsop	6.1	77%	23%
Columbia	9.4	93%	7%
Coos	19.7	5%	95%
Crook	7.2	100%	0%
Curry	9.2	77%	23%
Deschutes	56.1	100%	0%
Douglas	20.9	86%	14%
Gilliam	7.2	0%	100%
Grant	4.7	0%	100%
Harney	3.8	0%	100%
Hood River	4.4	100%	0%
Jackson	35.5	100%	0%
Jefferson	16.4	100%	0%
Josephine	33.1	60%	40%
Klamath	13.6	46%	54%
Lake	5.2	15%	85%
Lane	47.8	100%	0%
Lincoln	11.7	90%	10%
Linn	30.2	76%	24%
Malheur	10.5	39%	61%
Marion	48.0	100%	0%

County	Total Sprawl 1982 to 2015 (square miles)	% of Total Sprawl Related to POPULATION GROWTH	% of Total Sprawl Related to GROWTH IN PER CAPITA LAND CONSUMPTION
Morrow	5.0	100%	0%
Multnomah	34.1	100%	0%
Polk	14.2	100%	0%
Sherman	0.2	N/A	N/A
Tillamook	13.0	45%	55%
Umatilla	23.0	53%	47%
Union	7.7	27%	73%
Wallowa	3.1	0%	100%
Wasco	8.3	59%	41%
Washington	57.0	100%	0%
Wheeler	2.5	0%	100%
Yamhill	12.7	100%	0%
All Oregon Counties	**655.9**	**82%**	**18%**

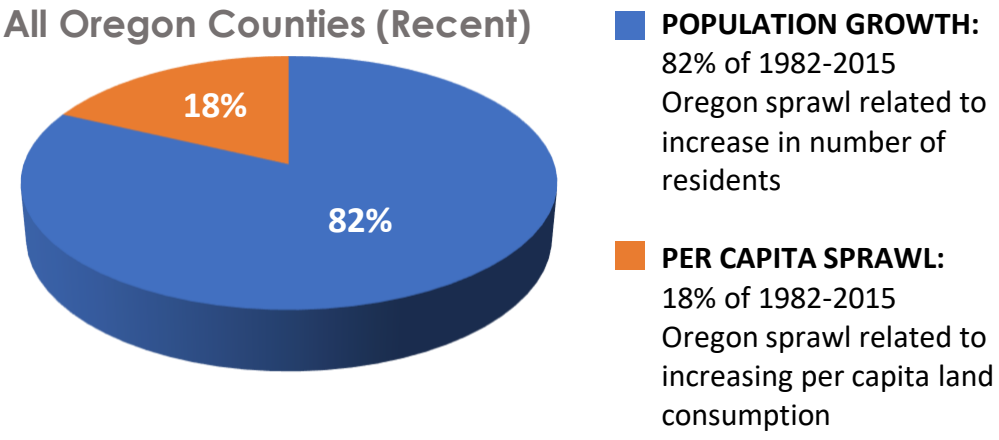


Figure 20. Sprawl Factors (Increasing Population and Increasing Per Capita Land Consumption) in all Oregon Counties, 1982-2015

Between 1982 and 2015, the increase in Developed Land in Oregon's 36 counties sprawled across and consumed 656 additional square miles (419,800 acres) of land in aggregate. **Figure 21** shows that population growth in Oregon's counties was responsible for more than four times as much loss of rural land as Per Capita Sprawl or rising land consumption per capita: 540 square miles vs. 116 square miles.

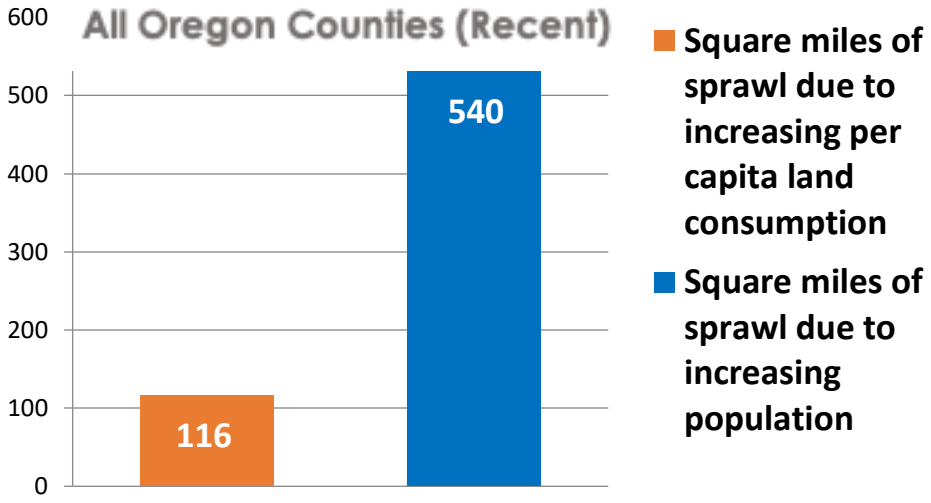


Figure 21. **Rural Land Lost to Per Capita Sprawl vs. Population Growth in Oregon Counties from 1982 to 2015**

Unlike the Census Bureau data, the NRCS survey 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, mines, parking areas, and sprawling towns under 50,000 residents. Some of these developed land uses are non-residential in nature but nevertheless constitute an integral part of the economic system that provides jobs, raw materials, and/or services to human populations residing elsewhere. Finally, on a national scale, the NRI category of Developed Land called "Rural Transportation" accounted for almost 20 percent of all developed land in 2012.

4.2 Oregon Sprawl Factors Compared to U.S. Sprawl Factors

It is interesting to compare the relative amounts and causes of sprawl in Oregon and other states using the NRI dataset on Developed Land. Here we do so for the entire NRI time period, from 1982 to 2015. This covers the complete three-decade-plus period of NRCS NRI land use data.

Figure 22 shows that across the entire 33-year time span between 1982 and 2015, about two-thirds (66%) of all open space developed in the United States was associated with population growth and about one-third of all open space developed (34 percent) was associated with increasing per capita land consumption (Per Capita Sprawl).

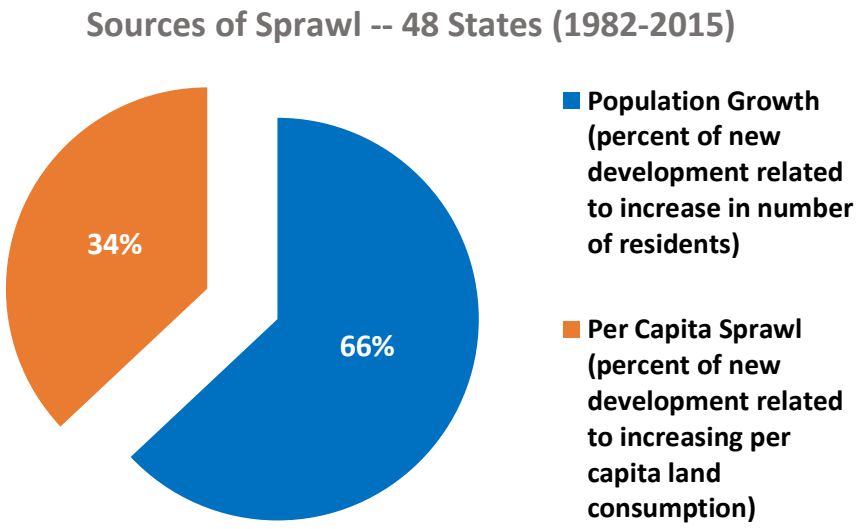


Figure 22. Sources of Sprawl in 48 Contiguous States, 1982-2015
Source: NRCS National Resources Inventory, 1982-2015

During the same time period, 82 percent of Oregon's sprawl was related to population growth. Therefore, it is evident that a higher share of Oregon's Overall Sprawl was associated with population growth than was the case nationally, 82% versus 66%. Another way of looking at this is that Oregon's land planning and land conservation efforts and initiatives (such as Urban Growth Boundaries) succeeded in raising the population density in newly and previously developed areas, thereby reducing the rate of sprawl. Yet this also raises the percentage of the reduced amount of sprawl that does occur which is attributable to population growth.

4.3 Scatter Plots of Population Growth and Sprawl

Another useful way to examine the relationship between the factors that drive sprawl is by using scatter plot analysis**. Figure 23** is a scatter plot for Oregon that examines the relationship between each of the 36 counties' population size in 2015 with its developed land area (in acres), or cumulative sprawl, in that same year. The scatter plot has a "best fit" line that shows the linear relationship between the data points.

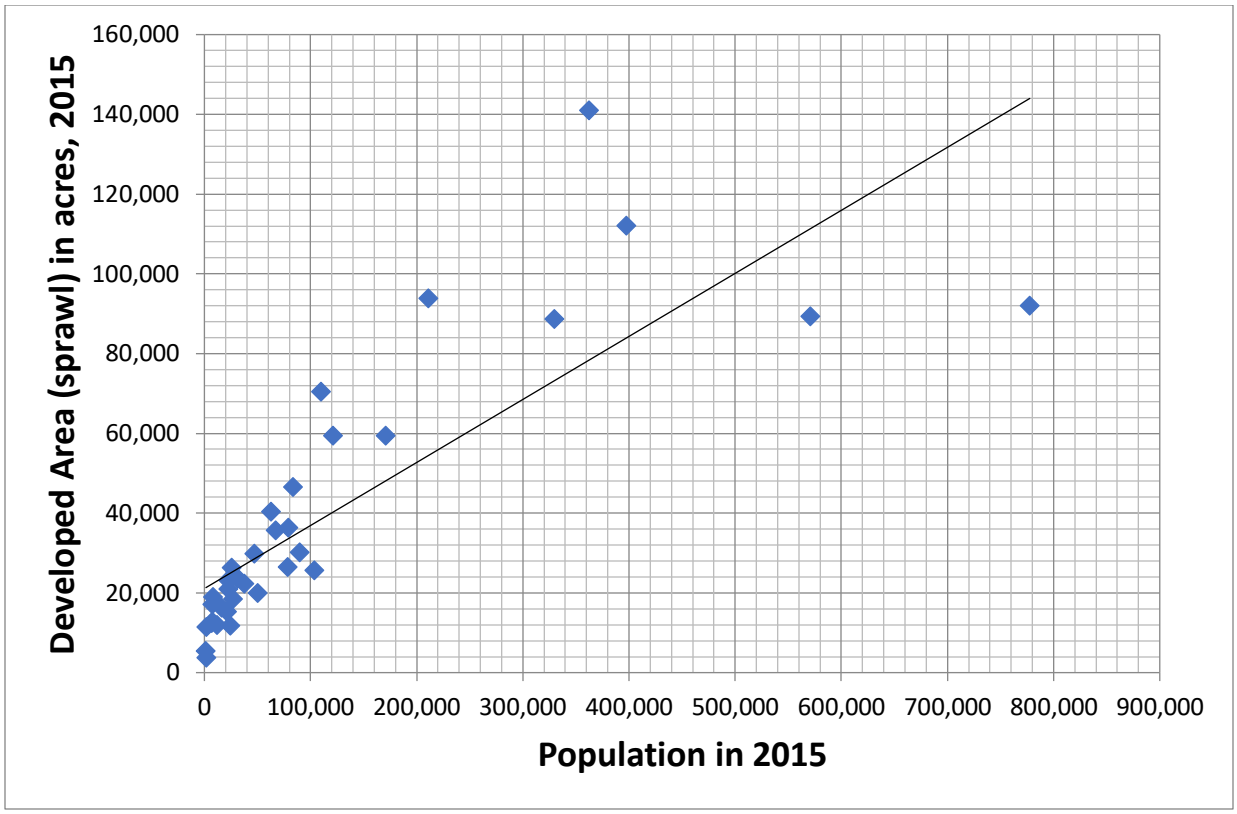


Figure 23. **Scatter Plot of Population Size vs. Sprawl (Developed Area) in 36 Oregon Counties in 2015**

Sources: Census Bureau and National Resources Inventory

The population size in 2015 is shown on the x-axis (horizontal axis) and the cumulative area of developed land (Overall Sprawl) in 2015 is shown on the y-axis (vertical axis). Each blue diamond represents one Oregon county, its location on the graph determined by where its population and cumulative developed area intersect.

The left-to-right, upward-trending "best fit" line for **Figure 23** indicates that population size is positively correlated with Overall Sprawl, or total area of cumulatively developed land. As a rule, a larger county population signifies a larger developed area, that is, counties with larger populations were generally also those where more land has been developed cumulatively (with some exceptions of course). These results are perhaps not surprising – that by and large, more people entail more land development – but if sprawl and population growth were not related, as some sprawl activists have always contended, 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 growth always causes sprawl, it does strongly suggest and reinforce the hypothesis that the two are closely linked.

Figure 24 graphs the percentage increase in Oregon counties' developed land (Overall Sprawl) from 1982 to 2015 as a function of their percentage population growth over those 33 years.

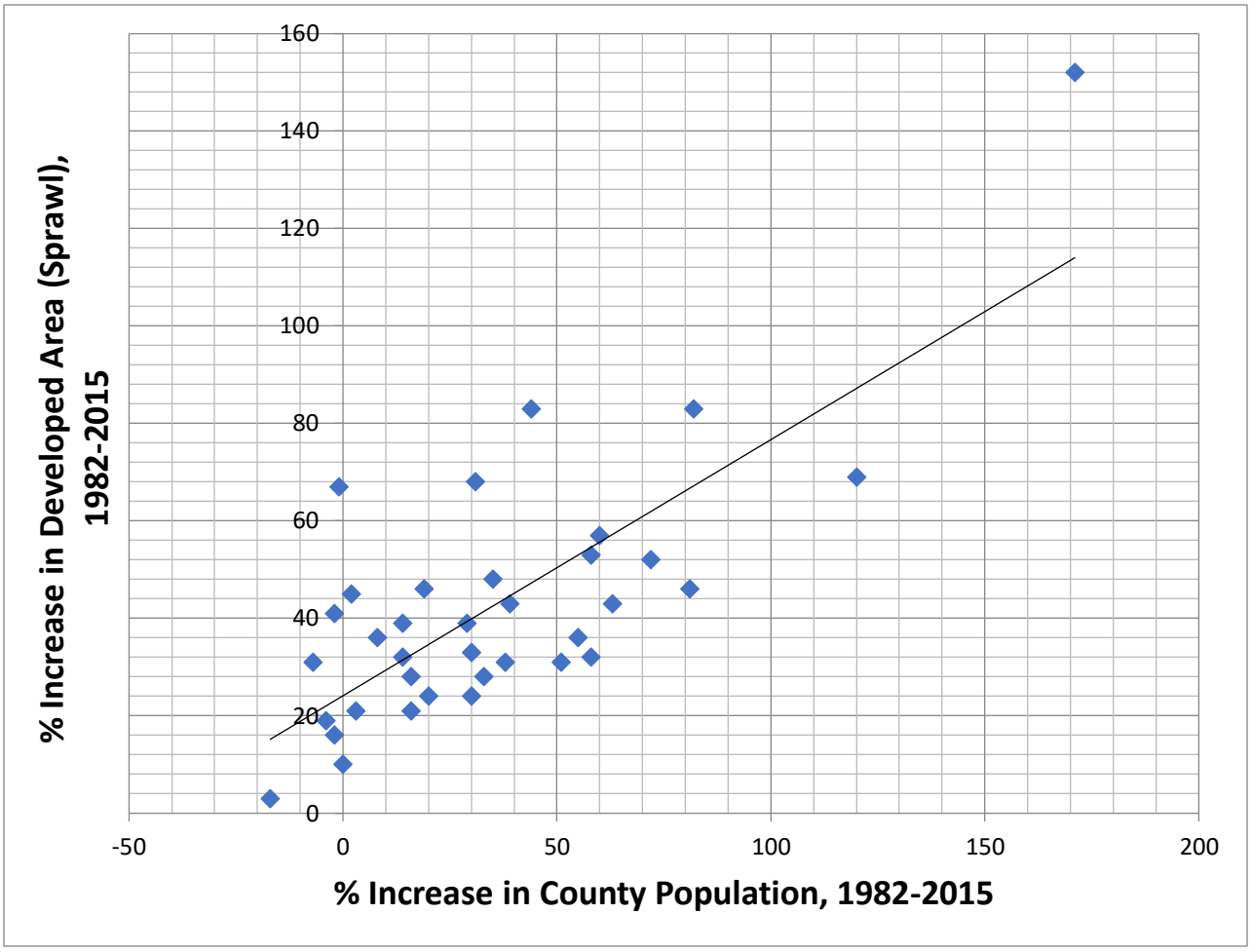


Figure 24. **Scatter Plot of Percent Increase in Developed Land Area (Sprawl) in All 36 Oregon Counties between 1982 and 2015 as a Function of Percent Population Growth**
Sources: Census Bureau and National Resources Inventory

Once again, the left-to-right, upward-trending "best fit" line for **Figure 24** indicates that the percentage increase in sprawl (growth in Developed Land from 1982 to 2015) is positively correlated with the percentage increase in population over those 33 years. Counties with a higher percentage of population growth had a higher percentage increase in developed land area, i.e., sprawl. Sprawl is clearly a function of population growth.

4.4 Comparing Oregon Sprawl to National Sprawl

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

Likewise, and even more conclusively, the addition of 412,770 new residents to Oregon's Urbanized Areas between 2000 and 2010 was responsible over 90 percent of all sprawl in the Beaver State.

At the national level, NRCS data on sprawl in the contiguous 48 states from 2002-2010 were also consistent with our findings for the cities. From 2002-2010 population growth was the most important factor in the loss of non-federal rural land, accounting for 91 percent of new development. The ten states experiencing the most sprawl by percentage (Nevada, Utah, Arizona, Delaware, Texas, Florida, Arkansas, Oklahoma, Mississippi, and Georgia) had populations that grew on average more than three times as fast as the ten least sprawling states by percentage (Massachusetts, Minnesota, Rhode Island, New York, Kansas, Connecticut, New Jersey, Nebraska, South Dakota and North Dakota) (**Figure 25**).

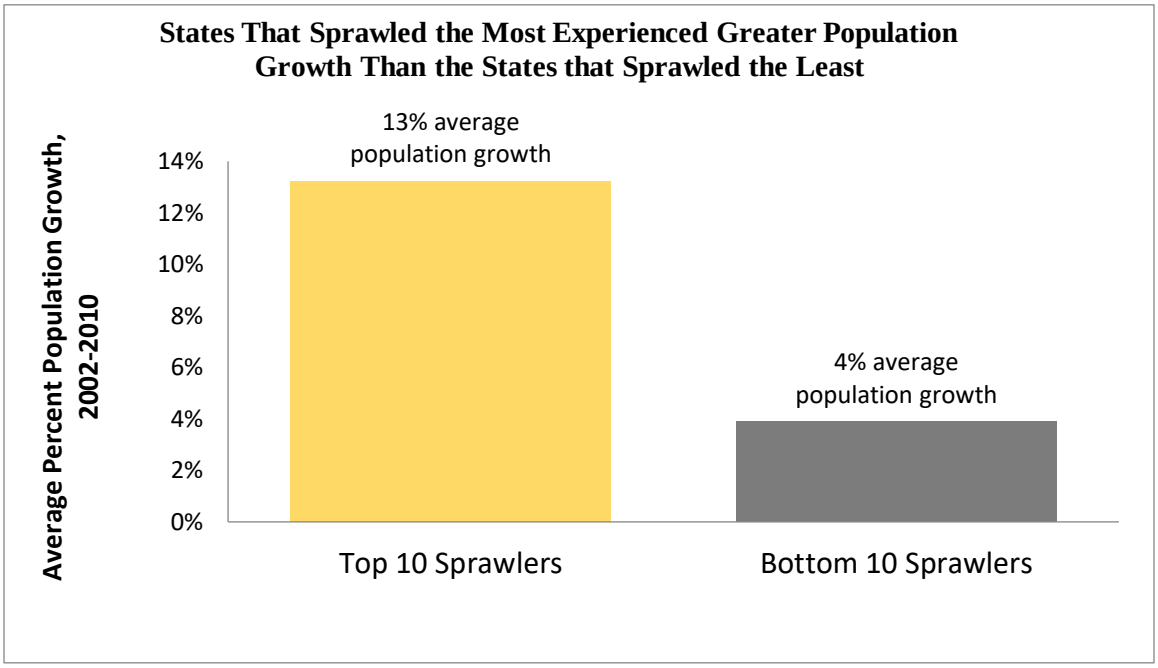


Figure 25. **Comparison of Population Growth between High and Low Sprawling States**

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

Figure 26 looks at the same data and the similar 2002-2010 time period from a different angle.

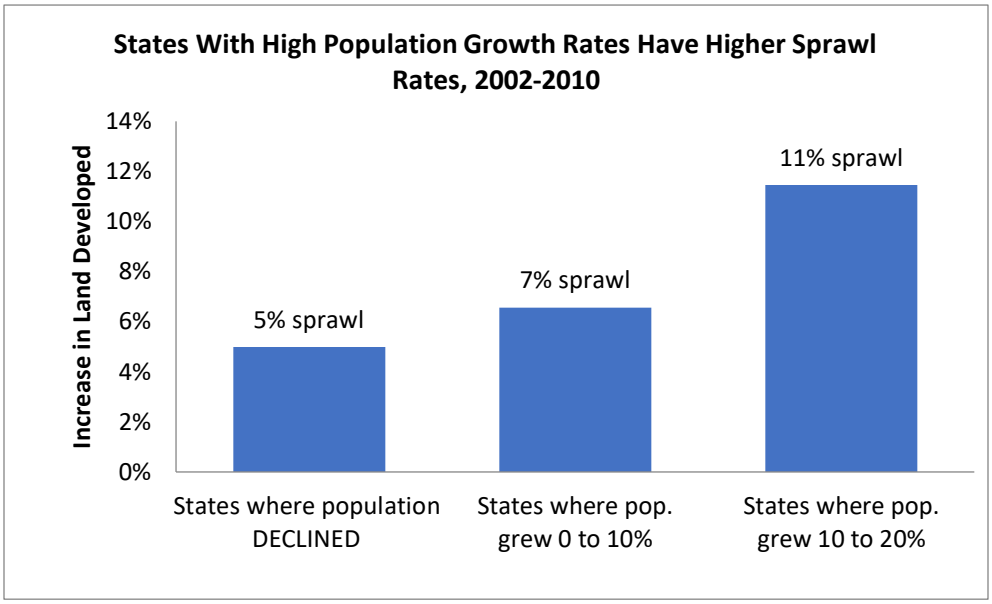


Figure 26. **Comparison of Sprawl in Slow-Growing vs. Fast-Growing States**

Table 19 ranks the states according to their sprawl rate (percent increase in Developed Land) over the entire period of record from 1982 to 2015, from highest to lowest, by percentage. Oregon was in 33rd place in the highest rate of overall sprawl for the 1982-2015 time period, more than halfway down. Since Oregon experienced higher than average population growth during this time period – 51 percent versus 39 percent – the fact that it limited its sprawl to 43 percent – compared to the national average of 60 percent – by increasing population density through the use of urban growth boundaries represents a success story, or at least a partial success story, because of course Oregon did not halt sprawl entirely by any means. In these 33 years alone, 419,800 acres (656 square miles) of open space were still lost permanently.

Table 19. **Sprawl in 48 States 1982-2015, Ranked by Percentage**

Ranking (by percentage) 1982-2015	State	Total Sprawl (percentage) 1982-2015
1	Nevada	136%
2	Arizona	113%
3	Georgia	108%
4	North Carolina	106%

Ranking (by percentage) 1982-2015	State	Total Sprawl (percentage) 1982-2015
5	South Carolina	98%
6	Florida	96%
7	Utah	96%
8	Tennessee	89%
9	Kentucky	87%
10	New Mexico	85%
11	Delaware	85%
12	New Hampshire	82%
13	West Virginia	82%
14	Alabama	78%
15	Texas	75%
16	Virginia	75%
17	Maine	72%
18	Idaho	64%
19	Mississippi	63%
20	Colorado	63%
21	Pennsylvania	61%
22	Louisiana	59%
23	New Jersey	58%
24	Massachusetts	58%
25	Maryland	56%
26	Washington	56%
27	Arkansas	53%

Ranking (by percentage) 1982-2015	State	Total Sprawl (percentage) 1982-2015
28	California	53%
29	Vermont	52%
30	Michigan	49%
31	Ohio	47%
32	Oklahoma	47%
33	**Oregon**	**43%**
34	Indiana	42%
35	Minnesota	41%
36	Wisconsin	40%
37	Missouri	39%
38	New York	36%
39	Rhode Island	36%
40	Illinois	32%
41	Montana	30%
42	Wyoming	30%
43	Connecticut	29%
44	Kansas	23%
45	Iowa	20%
46	South Dakota	19%
47	North Dakota	16%
48	Nebraska	15%
	Average All States	**60%**

Source: 2015 NRCS National Resources Inventory

5. CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Conclusions

At both the state level of Oregon 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 27**, a simple scatter plot of the 48 contiguous states' cumulative populations and developed land areas in 2010. The positive (upward tilting toward the right) slope of the best-fit line means that as a state's population increases, the area of built-up, developed land increases as well. This demolishes the whimsical notion entertained by those prone to wishful thinking and fairy tales that there is an insignificant connection between population size or growth rates and environmental consequences.

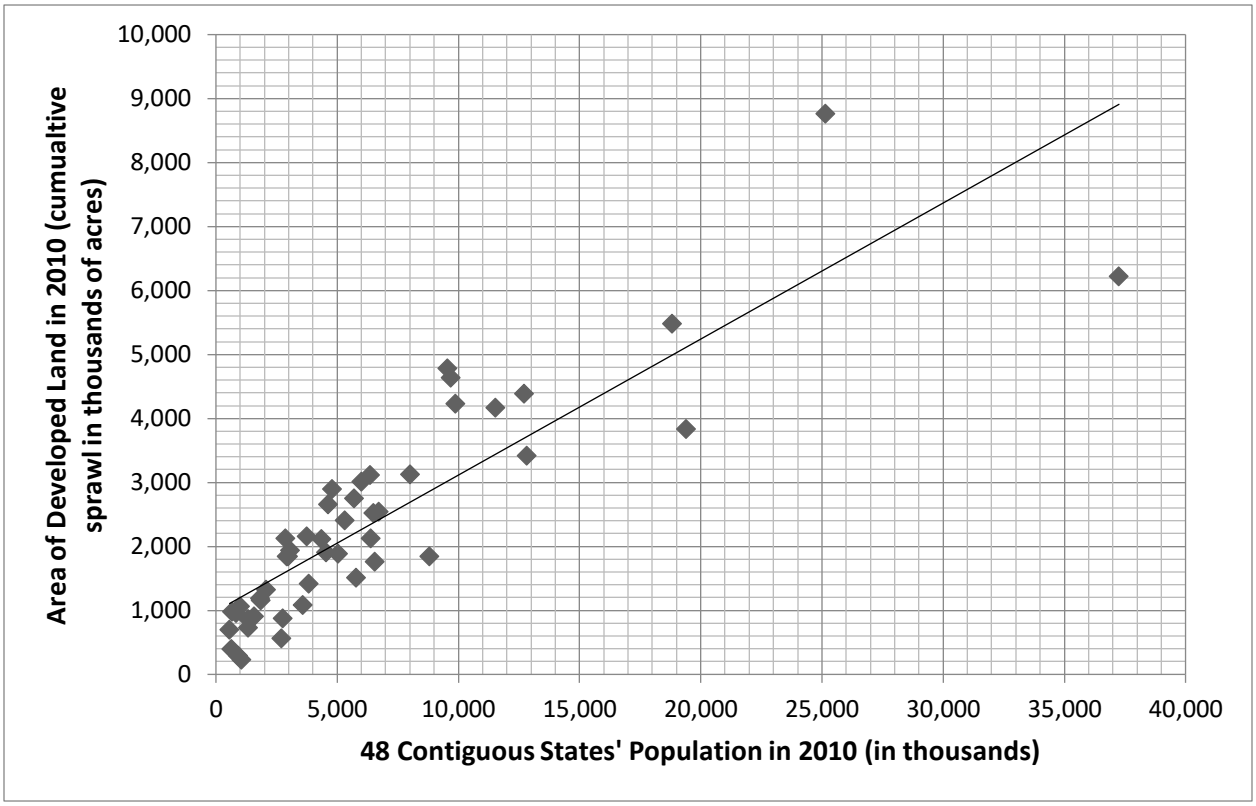


Figure 27. **Cumulative Developed Land Area (Sprawl) Is a Function of Population Size**
Source: U.S. Census Bureau; NRCS, 2013. *Summary Report: 2010 National Resources Inventory*

Sprawl continues to devour rural land around Oregon cities at a rapid rate.

Table 4 in Section 2.1 shows the increase in developed land in Oregon from 1982 to 2015. It also shows the annual daily rates of sprawl.

Although the pace of sprawl in Oregon appears to have peaked in the late 1990s at the rate of 60 acres per day (21,780 acres annually) our most recent data show that it continues to devour open space at a rate of nine acres per day, or more than 3,330 acres per year. In all likelihood, this rate has accelerated with the gradual waning of the Great Recession, though we don't yet have the data to confirm this hypothesis.

Smart growth efforts, the 1973 Urban Growth Boundary law (SB 100), higher gasoline prices, fiscal and budgetary constraints (limiting new road-building, for example), and the recession-inducing mortgage meltdown may have all played roles in slowing Oregon's rate of sprawl late in the first two decades of this century. The extent to which any of these and still other unforeseen factors may affect the rate of sprawl in the coming decades is unknown and unpredictable. Yet as more and more of Rural Oregon succumbs to development – chipped away and clogged with roads, vehicles, people, facilities and infrastructure – at some point it will not be possible to maintain this rapid rate of sprawl simply because other critical land uses – e.g., high-value 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.

The role of population growth in driving sprawl in Oregon has stayed consistently high over the last several decades but appears to have increased somewhat over time.

In the 1980s and 1990s, population growth accounted for approximately 80 percent of sprawl in Oregon.[86] In this century, it has accounted for between 80 to 90 percent of sprawl. In both Oregon and nationwide, down through the decades, the role of population growth as a driver of sprawl has increased, while the role of increasing per capita land consumption (what we have referred to as "land use choices" or Per Capita Sprawl) has decreased.

In our 2001 study of sprawl at the national level (*Weighing Sprawl Factors in Large U.S. Cities*), we found that population growth was responsible for about half of sprawl in the 100 largest Urbanized Areas in the country. Land use choices, or per capita sprawl, accounted for the other half. In contrast, in our 2014 study of national sprawl, *Vanishing Open Spaces*, using data from the same two federal agencies (U.S. Census Bureau and NRCS) and the same two long-term data gathering and inventory programs, during the decade just passed (2000-2010), population growth accounted for approximately 70-90 percent of sprawl on the national scale; declining density or increasing per capita land consumption accounted for about 10-30 percent.

[86] Roy Beck, Leon Kolankiewicz, and Steven Camarota. 2003. *Outsmarting Smart Growth: Population Growth, Immigration, and the Problem of Sprawl*. Center for Immigration Studies. August.

In other words, nationally, the relative role of the population growth factor has increased by about 20-40 percentage points (from 50 to 70-90) over the four-decade period from 1970 to 2010 that the series of study encompassed.

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

A central goal of Smart Growth is to preserve open space, farmland, natural beauty, wildlife habitat, and critical environmental areas by preventing or minimizing the declining population density of urbanized/developed areas and thus avoiding "low-density sprawl". Therefore, places where population density increases should be hailed as success stories. Oregon has many such success stories. Between 2000 and 2010, density increased (per capita land consumption decreased) in seven out of the 10 Urbanized Areas in the state. However, these UAs that increased their density (reduced their per capita land consumption) still experienced appreciable sprawl, totaling 41,664 acres between 2000 and 2010. This was about 67 percent of combined sprawl in all Oregon UAs.

Similarly, the population density of developed areas increased in 21 out of Oregon's 36 counties from 2002 to 2015 (that is, in 58 percent of the counties). Even so, in spite of their increasing population density, the developed areas in these 21 counties still sprawled across an additional 52,700 acres of rural lands, comprising 68 percent of all the new lands developed in the state during these years.

No large city in the United States has come close to **Portland, Oregon** in the lengths it has gone to control 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 5.31% from 0.19 acre per person to 0.18 acre per person. (By comparison, the average per capita 2010 land consumption in the Urbanized Areas of Texas, the most booming state in the nation, was 0.24 acre/person, 33 percent higher than Portland.)

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 offset 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, agriculturally important Willamette Valley as people seek sanctuary from higher home prices. Supporting this contention is the nearby city of Salem, whose

urbanized area population grew by 14 percent from 2000 to 2010, and which is now vying with Eugene as the second most populous city in Oregon.

Of the 192 Urbanized Areas in the entire United States which over the 2000-2010 decade experienced a decline in per capita land area, **Raleigh, North Carolina** is another informative example of the limits of gradually shrinking the acreage afforded to each person in which to live, work, shop, play. Per capita land consumption decreased by 0.003 acre. At the same time, the population grew by over 300,000 people, causing the Raleigh UA to become more densely populated. Yet 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 these 10 years.

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

In Texas, the **Houston UA** reduced its per capita land use (increased its density) slightly from 0.217 acre/person in 2000 to 0.215 acre/person in 2010, a decrease of almost one percent. According to the conventional wisdom voiced by Smart Growthers, because density increased, by definition there should have been 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 sprawl studies almost two decades ago, 18 of the 100 largest Urbanized Areas in the United States had reduced per capita land consumption between 1970 and 1990, 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 nonetheless 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 if the country is to avoid moving toward a critical shortage of rural lands.

Stabilized population alone does not prevent sprawl.

In **Pittsburgh, Pennsylvania**, many local officials see population growth as a driver of economic development and an indicator of the vibrancy of the locales they represent. This mentality is seen in the aggressive campaigns and taxpayer subsidies that local officials use to attract new residents. However, economic growth does not necessarily require growing populations and sprawling cities. According to a 2012 study by Eugene-based 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.[87]

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

Pittsburgh made headlines in the 2000s as one of the country's most livable cities. In 2011 *The Economist* Intelligence Unit named it America's most livable city, and the 29th most livable city in the world. Despite having a stable population and diverse economy, the Pittsburgh Urbanized Area sprawled over an additional 52.8 square miles from 2000 to 2010. The reason was high levels of Per Capita Sprawl. One possible culprit could be that Pittsburgh has fewer people per household than the nationwide average. This means that the population of Pittsburgh requires more dwellings and more area for the same population size than do other American cities of comparable population size. Also, the decline of the steel industry left parts of the city abandoned as "brownfields", driving residents to build outward into the suburbs. Cases like Pittsburgh highlight the necessity of a two-pronged approach to addressing both population growth – undertaken primarily at a national level, not a local one – and per capita consumption sprawl, undertaken primarily at the local level.

Downtown Pittsburgh, Pennsylvania, where the Monongahela (right) and Allegheny Rivers (left) combine to form the Ohio River at The Point

[87] 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.

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 25 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.

5.2 Policy Implications

In order for Oregon policy makers to reduce the negative impacts of sprawl and over-development, they must adopt a two-pronged approach. Building on the findings of our original studies in 2000 and 2001, and using the same analysis of U.S. Census Bureau and USDA National Resource Conservation Service data, this study provides further evidence of the necessity for addressing the causes of both per capita land consumption growth and population growth in the state.

Oregon residents and leaders with deep concerns about the negative effects of habitat and farmland destruction must aggressively engage remedies for both causes of sprawl if they hope to achieve their goals of stopping the sprawl that continues to chew away at the remaining undeveloped lands of western Oregon, primarily but not exclusively in the Willamette Valley.

The results of this study suggest that despite Oregon's national leadership in reducing wasteful over-consumption of land, about a tenth to a fifth of recent sprawl has continued to be related to growth in per capita land consumption caused by a complicated array of zoning laws, infrastructure subsidies, and complex socioeconomic forces. While the findings of this study directly challenge many Smart Growth assumptions that have minimized or ignored the role of population growth in sprawl, these findings do not discount the necessity for even smarter, more effective, and more efficient urban planning that reduces per capita land consumption. Additional efforts to make cities and communities more space-efficient and livable are certainly needed,

But in pursuing Smart Growth and New Urbanism solutions, Oregon officials have generally neglected the role of population growth. Our study finds the state's population growth is related

to 91 percent of the sprawl in the state's 10 Urbanized Areas (according to 2000-2010 Census data) and 81 percent of sprawl in all Oregon counties (according to 2002-2015 National Resource Conservation Service data).

Furthermore, this study finds that the role of population growth in contributing to Overall Sprawl has remained high in Oregon, higher than the national average, from the 1970s to the present. 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 population pressures facing many communities in Oregon.

Given the challenge of handling 1.35 million new residents between 1982 and 2015, Oregon's officials were clearly unable or unwilling to accommodate both the new residents and existing residents within existing urbanized areas while using only the existing amount of land for public and commercial infrastructure to support the larger population. The result was 656 square miles (420,000 acres) of lost natural habitat and farmland.

A public opinion survey of 1,000 Oregon voters in October 2019, just for this study, found that most are supportive at least in theory of tackling the population growth that is such a major factor in destruction of natural and agricultural resources, primarily near where most people live. Informed that "most of the increased suburban development and the reductions of open spaces in Oregon in recent decades was related to population growth," more than two-thirds of respondents (68%) preferred that Oregon's population "grow much more slowly" or "stop growing." Another 12 percent preferred that the state's population "become smaller."

Only 13 percent of Oregon voters indicated they were okay with the present rate of the state's population growth.

10* A study of government data found that most of the increased suburban development and the reduction of open spaces in Oregon in recent decades was related to population growth. Would you prefer that Oregon's population continue to grow at the recent rapid rate, that it grow much more slowly, that it stop growing, or that it become smaller?

13% Prefer Oregon's population grow at recent rapid rate
48% Grow much more slowly
20% Stop growing
12% Become smaller
7% Not sure

The desire for slower or no population growth by most Oregon voters shows an environmental sensibility in line with the findings of the Population and Consumption Task Force of President Clinton's Council on Sustainable Development. It concluded that long-term environmental sustainability in the United States requires a stabilization of the U.S. population. The findings of this study certainly confirm that principle for the sustainability of Oregon's habitats in

quality and quantity capable of supporting the 16 mammal species and subspecies, eight birds, four reptiles, one amphibian, 25 fish, and 59 plant species that are listed currently as threatened or endangered in the state.

5.2.1 Local Influence on the Per Capita Consumption and Population Factors in Sprawl

Local policy makers truly trying to curb sprawl in Oregon towns and cities have a number of policy actions and instruments to pursue.

Residents and officials of each jurisdiction can start by addressing the question of whether they want their municipality to grow in population size, and if so, by how much and how fast. Any decision that most residents want growth to east slow down significantly moves the citizens to additional questions, such as what purpose should the population growth serve and then how to encourage only that kind of growth, as well as how to accommodate it within the existing urban footprint.

The concept that residents have any say at all in whether their home communities encourage population growth has not been the prevailing one across the country. But one key action taken by many towns and cities across the country to exercise some control over population growth has been to devise procedures that require new developments to pay for all additional costs of accommodating new residents.

Most local officials around the country see population growth as an indicator of the vibrancy and vitality of their respective communities. But there is little evidence to suggest that unfettered population growth is necessarily any of those things. Well-known Oregon-based sprawl critic and urban planner Eben Fodor, author of *Better Not Bigger*,[88] challenged this very notion in his 2012 study "Relationship between Growth and Prosperity in 100 Largest U.S. Metropolitan Areas."

Fodor's study found that rapidly expanding metropolitan areas did not hold up well in terms of standard economic indicators such as unemployment, per capita income, and poverty rates in comparison with slower growing metropolitan areas. Yet, despite this, local officials and city planners continue to offer subsidies and tax breaks to entice new residents, investment and development. Often these subsidies are born unfairly by existing residents, who are faced with rising property taxes and footing the bill for sprawling highways, new schools, water and wastewater treatment facilities, and energy grids ever farther from the urban core.

Many cities have overly complicated zoning laws that drive up home prices. New immigrants and low-income families are being priced out and into the more affordable suburbs, and often in developments on the edge of or beyond the suburbs. In order for cities to properly address sprawl, a step in the right direction would be removal of taxpayer subsidies so that the true costs of development are borne by developers, as suggested by the

[88] Ibid.

work of Oregon planner Eben Fodor. Harvard economist Edward Glaeser suggests the true social costs of activities such as driving should be paid for. More sensible planning policies and zoning ordinances can help curb sprawl and reduce the size of population booms in areas not suited to handle large populations.

Of course, the people of a municipality can decide that they do prefer the zoning and planning that attracts population growth or increases per capita land consumption. But this study makes clear that a city can't choose that option and at the same time protect the natural habitat and farmland that surrounds it.

This study's public opinion poll provides an indication of why Oregon's elected officials have not received enough voter pressure to cause them to tackle the population growth problem in sprawl. True, the polling shows that most Oregonians strongly decry destructive sprawl, and only 13% said they prefer to continue the population growth rate that is causing most of it. But when it comes to specific ways to actually do something about it, the voters split almost right down the middle on whether local, state and federal governments should take the actions necessary to at least slow down the state's population growth.

12* Another major source of Oregon's population growth is people moving in from other states. Should local and state governments in Oregon make it more difficult for people to move to Oregon from other states by restricting development?

41% Yes
41% No
18% Not sure

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

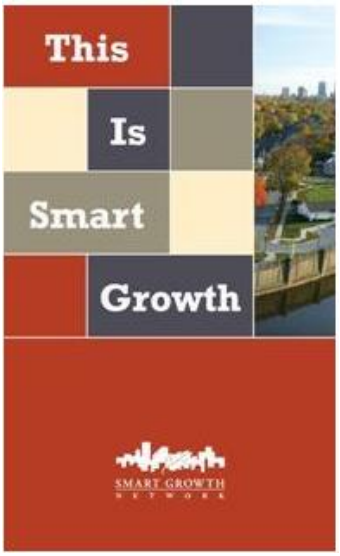
The majority of population growth in Oregon comes from people moving from other states. Many of the citizens who want a lot less population growth, though, answered the survey that they don't think local and state governments should restrict development to make it more difficult for people in other states to move into Oregon communities.

Although 80% said they want significant reductions in population growth on Question 10 only 41% on Question 12 said they favor development restrictions to reduce population growth coming from other states. An identical 41% said they don't support the restrictions. Still, the

41% support for restrictions may be seen as a very high mark for citizens who rarely hear local and state leaders discussing the idea of limiting population growth.

Question 13 provides a look into citizen attitudes about more aggressive government roles in guiding residents into smaller residences and higher density housing. The result also showed a fairly close split in opinion. Almost half (48%) strongly or somewhat favored zoning and other regulations that would result in more residents living in apartment and condo buildings instead of single-family houses, while 41% strongly or somewhat opposed such measures.

The plurality support for the higher density solution suggests one reason Oregon officials have felt free to move forward with Smart Growth initiatives. But strong objection to higher-density housing (41%) also suggests a reason officials have not resisted steadily moving their Urban Growth Boundaries outward to accommodate extra population rather than keeping it inside existing boundaries at significantly higher densities.



The tools for squeezing population growth into existing urban footprints or by minimizing sprawl are many. 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 tips and 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

The organization Oregon Smart Growth (OSG) belongs to the national group Smart Growth America. It advocates for "development that's economically, socially, and environmentally sustainable."[89] 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".[90]

This publication explains that:

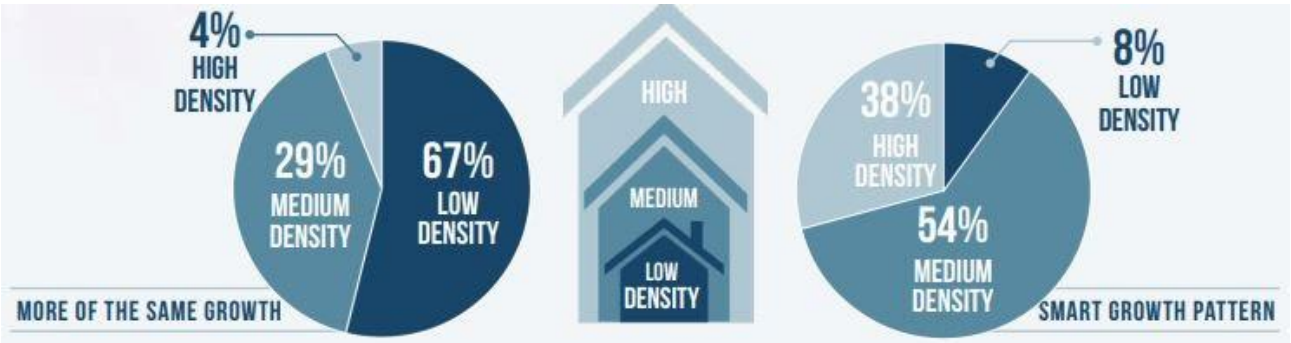
> At its most basic level, Smart Growth achieves higher density than current housing development patterns and therefore requires less land to accommodate the same number of units. In Oregon, Smart Growth requires just 18% of the land area required for the More of the Same scenario. Utilizing less land 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. The net result

[89] Oregon Smart Growth website at https://www.oregonsmartgrowth.org/.
[90] "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.

would be much higher population density overall within the state's Urbanized/Developed Areas.



Source: "Housing Underproduction in Oregon"; footnote 87.

In our view, 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 and perspective 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 steadily devouring the countryside, wildlife habitat, and farmland, perhaps later rather than sooner, but no less certainly.

Under the Smart Growth Pattern in a state of high population growth, a particular open space, farm, or habitat beyond the urban growth boundary that might have taken a decade to be converted permanently from green ground to brown pavement and buildings under the business-as-usual ("More of the Same Growth") approach might now take two or three decades to disappear under asphalt instead. To us, while this is better, it is not good enough, and it is not environmentally sustainable.

The late University of Colorado physics professor, famed population educator, and local growth control activist (in Boulder, Colorado) Dr. Albert Bartlett wrote that "smart growth will destroy the environment, but it will do it in a sensitive way." We would offer our own rephrasing as: smart growth is necessary but not sufficient to save the environment and open spaces.

Tupelo Alley – a mixed-use, LEED Gold building near public transit cited as an example of smart growth in Portland, Oregon by the U.S. Environmental Protection Agency

5.2.2 National Influence of Population Growth

Beyond the short term, local Oregon residents, activists, and officials supportive of growth control and management can hope only to slow population growth in their jurisdictions if national population continues to increase on average by about 2 to 3 million additional residents each year. These 20-30 million additional American residents per decade each have to settle somewhere, in some community or other, inevitably leading to additional sprawl pressures as far and as long as the eye can see.

In the coming decades, many people will choose to seek a home in Oregon, as indicated by official demographic projections of the State of Oregon's Office of Economic Analysis in the Department of Administrative Services.[91] Oregon's population is projected to grow from 4.0 million in 2015 to 5.6 million by 2050, approximately double the state's population in 1990. According to these projections, in 2050, Oregon's population would still be increasing by tens of thousands annually and some 300,000 to 400,000 every decade.

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

- Native fertility: At approximately 1.7 births per woman, the total fertility rate (TFR) 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.

[91] State of Oregon, Department of Administrative Services, Office of Economic Analysis. 2013. Forecasts of Oregon's County Populations and Components of Change, 2010-2050. Available online at: https://www.oregon.gov/das/OEA/Pages/forecastdemographic.aspx.

- 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 above native fertility.

Thus, long-term population growth in the United States and Oregon 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 and1960s to over a million since 1990. Until the numerical level of national immigration is addressed, even the best local plans and political commitment will be unable to stop sprawl.

Unless Americans and immigrants decide to move to a one-child-per-woman average (about half the 2.1 replacement level), any serious efforts to halt the loss of farmland and wildlife habitat in Oregon must include reducing the volume of population growth, which requires lowering the level of immigrants entering the country each year.

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 America's likely voters in 2014 by Pulse Opinion Research found that reducing immigration was a popular policy choice among most when linked with the goal of slowing down U.S. population growth (see Appendix F for the full survey questions and results).

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

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.[92]

As with the solutions of restricting development for people moving from out of state and restricting development toward smaller and denser housing, the solution of reducing annual federal immigration to protect Oregon's natural habitat and farmland did not get majority support from Oregon's citizens. However, reducing immigration to slow down population growth was the top choice of citizens (46%).

11* U.S. Census data show that about 30% of population growth in Oregon in the most recent decade is from new immigrants and births to immigrants. Should the federal government reduce future immigration to slow down population growth, keep future immigration and population growth at the current rate, or increase annual immigration and population growth?

46% Reduce future immigration to slow down population growth in Oregon
33% Keep future immigration and population growth at current rate
11% Increase immigration and population growth
10% Not sure

Like many policy goals, protecting Oregon's farmland and threatened animal, bird and plant species and their habitats from sprawl is in tension with citizen opinions about other issues.

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

But as this study shows, Oregon cannot continue its population growth and expect to have in the future the state that citizens say they want in protected habitat and farmland

That is why another federal commission in the 1990s recommended far greater reductions in immigration than the roughly 500,000 suggested by Barbara Jordan's commission. The President's Council on Sustainable Development in 1996 stated that the United States should 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."[93]

It is important to note that the additional sprawl that occurs because of high immigration levels has nothing to do with the quality 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 greater or lesser effect on sprawl than a net population growth of the same size from U.S.-born residents. We could find no precise method of quantification but concluded that the various factors largely balanced each other.

A key way in which growth from immigration has a somewhat smaller effect on sprawl is the lower average income level and, thus, a lower consumption level of the average immigrant. But we found that an assumption about immigrants having less of an effect because they presumably prefer central cities to suburbs was false. The majority of immigrants now live in suburbs where the sprawl occurs.[94] 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

[93] 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.
[94] 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/

incomes were causing immigrants to move to the edges of cities and even to rural settlements beyond the cities to find cheaper housing.

Oregon's population growth is influenced by immigration in a major way not involving the actual immigrants settling in the state. Because California has experienced so many negative quality-of-life results from its massive population growth, Oregon receives a large number of California "refugees" fleeing the over-population. Because nearly all of California's population growth is due to immigration, much of the California migration into Oregon must be considered as another result of the quadrupled level of annual federal immigration since 1990.

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, directly and indirectly, add around 20-30 million people to the nation each decade, all of whom have to settle in some locality. The reality – which can only be partially mitigated but not eliminated by good planning or Smart Growth – is that these localities all occupy lands that were formerly productive agricultural lands or irreplaceable natural habitats.

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

Appendix A
Glossary

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

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

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

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

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

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

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

Immigration – Permanent movement (i.e., settlement) of a foreign-born person to the

United States either with permission from U.S. authorities (legal immigration) or without such permission (illegal immigration).

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

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

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

Native Born – A person born in the United States.

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

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

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

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

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

Per Capita Sprawl – Sprawl that is driven by increase in per capita land consumption, that is, land consumption per resident, of an urbanized area, developed area, city or town; Per Capita Sprawl is measured in terms of the increase in acres or square miles of developed or urbanized acres of land per person. Per Capita Sprawl and population-driven sprawl add up to 100 percent of Overall Sprawl.

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

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

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

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

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

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

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

Urban Core – Used in this report as another description for "central location" as defined by the Census Bureau. The urban core is the entire city that anchors a metropolitan area, and usually is

at its center. It generally is the oldest, most densely populated and most built-up portion of an urbanized area.

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

Urban Sprawl – See "sprawl."

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

Appendix B
Calculating Per Capita Land Consumption

The per person or per capita land consumption in each Urbanized Area or each county's Developed Land 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 Land in a county or size of Urbanized Area
P = Population of the county or UA in question (or the entire state)

For example, in 2015 Oregon had 4,013,845 residents and approximately 1,393,800 developed acres. Thus, per capita developed land use for all purposes was around 0.347 acre (slightly more than a third of an acre) per resident.

The land used per person is the total developed land 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, county, or UA can be expressed as:

(2) $A = P \times a$

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

Appendix C

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

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

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

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

(1) $A = P \times a$

Where*:*

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

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

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

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

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

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

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

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

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

The same form applies for per capita land use:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

In the case of Oregon from 1982 to 2015, this formula would appear as:

(14) ln (4,013,845 *residents* / 2,664,930 *residents*) + ln (*0.347 acre per resident / 0.365 acre per resident*) = ln (*1,393,800 acres / 974,000 acres*)

Computing the ratios yields:

(15) ln (1.506) + ln (0.950) = ln (1.431)

0.410 + (-0.051) = 0.359

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 0.359:

(16)
$$\frac{0.410}{0.359} - \frac{0.051}{0.359} = \frac{0.359}{0.359}$$

Performing these divisions yields:

(17) 1.142 - 0.142 = 1.0

Thus, we note that in the case of Oregon from 1982 to 2012, the share of sprawl related to population growth was 114.2 percent [100 x (0.410 / 0.51)], while declining density (i.e., an increase in land area per capita) accounted for -14.2 percent [100 x (0.051 / 0.359)]. Note that the sum of both percentages equals 100 percent.

However, how can the share of overall statewide sprawl in Oregon due to population growth exceed 100%? It cannot. The 114% just derived is an artifact of the mathematics just used to derive it. What this number in excess of 100% indicates is that average per capita land consumption in the state as a whole decreased (i.e., average population density increased) over the 33-year period from 1982 to 2015. If the average per capita land consumption declined on the statewide scale, then by definition, increasing per capita land consumption could not have contributed to sprawl. However, this is somewhat misleading.

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 lends a proportionately greater weight to those counties with greater amounts of sprawl. In essence, sprawl in counties around Portland, for example, should not be attributed to population growth in counties around Bend. In this method, the amount of sprawl related to population growth in each county is summed for all 36 counties in

the state. This sum or aggregate is then divided by the total amount of sprawl in the state. Using this procedure, 82 percent of the sprawl in Oregon between 1982 and 2015 is shown to be associated with population growth, which the authors believe is a more accurate rendering of population growth's actual role than 100 percent. The gross 100% figure exaggerates population's role, and implies that virtually all sprawl in Oregon is related to population growth; this is not the case.

Appendix D

Anomalies – Urbanized Areas with Populations that Grew but Areas that Supposedly Shrank

From 2000 to 2010, Corvallis, Oregon (where Oregon State University is located) gained population, while at the same time losing overall urbanized area, according to the Census Bureau's decadal inventories of Urbanized Land in 2000 and 2010.

In 2000, the Corvallis UA occupied 29.98 square miles, while in 2010, it stood at just 21.11 square miles, a decrease of 7.87 square miles. At the national scale between 2000 and 2010, this also happened in a small fraction of other UAs, such as Panama City and Titusville in Florida and Victoria and Wichita Falls in Texas.

In each of these areas, the reduction in developed urban land was likely on paper only, the result of changes in assumptions and calculations by the Census Bureau. Although it is possible for an Urbanized Area to reduce its amount of actual developed land by returning large swaths of previously developed acreage to a natural, semi-natural, feral, or agricultural condition (as has happened in the case of Detroit, Michigan), that was not the case with these Urbanized Areas that the Census Bureau shows as having decreased in land area from 2000 to 2010.

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

Census Tracts, Blocks, and Block Groups

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

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

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

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

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

Source:

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

Appendix E

State Rankings of Area of Sprawl per Person in Newly Developed Land from 1982 to 2015 (back to p. 4)

(lower number reflects less sprawl)

State	Total Sprawl (square miles), 1982-2015	Population Growth, 1982-2015	SPRAWL PER PERSON (acres)	Ranking
California	3,371	14,212,435	**0.152**	1
Nevada	478	2,001,520	**0.153**	2
Florida	4,239	9,797,160	**0.277**	3
Arizona	1,749	3,912,401	**0.286**	4
Utah	683	1,426,603	**0.307**	5
Oregon	**656**	**1,351,615**	**0.311**	**6**
Washington	1,406	2,876,266	**0.313**	7
Colorado	1,188	2,378,881	**0.320**	8
Maryland	859	1,717,638	**0.320**	9
Texas	6,191	12,123,465	**0.327**	10
Delaware	214	344,959	**0.397**	11
New Jersey	1,070	1,529,033	**0.448**	12
New York	1,608	2,229,609	**0.462**	13
Virginia	2,145	2,873,984	**0.478**	14
Minnesota	1,112	1,351,788	**0.526**	15
Idaho	557	675,603	**0.528**	16
Georgia	3,770	4,549,741	**0.530**	17
Connecticut	382	454,849	**0.537**	18
Nebraska	262	311,784	**0.538**	19

State	Total Sprawl (square miles), 1982-2015	Population Growth, 1982-2015	SPRAWL PER PERSON (acres)	Ranking
Illinois	1,294	1,438,639	**0.576**	20
Rhode Island	97	101,746	**0.610**	21
North Carolina	3,920	4,022,668	**0.624**	22
Massachusetts	1,012	1,022,780	**0.633**	23
Indiana	1,175	1,142,674	**0.658**	24
Missouri	1,307	1,143,189	**0.732**	25
Tennessee	2,297	1,944,685	**0.756**	26
Wisconsin	1,252	1,030,874	**0.777**	27
Kansas	618	504,587	**0.784**	28
South Carolina	2,081	1,684,809	**0.791**	29
New Mexico	949	718,441	**0.846**	30
New Hampshire	516	382,415	**0.864**	31
Arkansas	1,016	681,369	**0.955**	32
South Dakota	245	163,439	**0.959**	33
Oklahoma	1,093	698,230	**1.002**	34
Montana	407	224,331	**1.162**	35
Vermont	216	105,346	**1.314**	36
Kentucky	1,543	738,612	**1.337**	37
Alabama	1,999	925,592	**1.382**	38
Iowa	503	230,284	**1.398**	39
Ohio	2,106	848,940	**1.588**	40
North Dakota	220	85,887	**1.636**	41
Michigan	2,146	802,972	**1.711**	42

State	Total Sprawl (square miles), 1982-2015	Population Growth, 1982-2015	SPRAWL PER PERSON (acres)	Ranking
Mississippi	1,163	428,520	**1.737**	43
Pennsylvania	2,662	945,978	**1.801**	44
Maine	568	191,103	**1.901**	45
Wyoming	250	79,702	**2.007**	46
Louisiana	1,144	318,603	**2.298**	47
West Virginia*	820	(109,837)	**N/A**	
All Contiguous 48 States	**67,161**	**88,615,912**	**0.485**	

Appendix F

Table 3. Changes in Acreage of Cropland, Pastureland, and Non-Federal Rangeland, and Forestland, 1982-2015 **(thousands of acres)** (back to page 4)

State	Year	Cropland	Pastureland	Non-Federal Rangeland	Non-Federal Forestland
Alabama	1982	4,464.7	3,793.9	53.7	20,876.8
	2015	2,274.9	3,220.2	50.7	21,887.4
	% Change	-49%	-15%	-6%	5%
Arizona	1982	1,253.0	83.6	33,366.4	4,572.6
	2015	898.2	44.4	33,341.4	4,179.1
	% Change	-28%	-47%	0%	-9%
Arkansas	1982	8,043.3	5,575.1	17.1	14,874.2
	2015	7,133.5	5,298.0	20.5	15,074.8
	% Change	-11%	-5%	20%	1%
California	1982	10,525.0	1,278.0	21,110.7	14,812.4
	2015	9,315.7	1,277.0	19,010.6	14,060.8
	% Change	-11%	0%	-10%	-5%
Colorado	1982	10,548.1	1,112.8	25,255.2	3,850.8
	2015	8,055.6	1,488.8	24,511.4	3,498.5
	% Change	-24%	34%	-3%	-9%
Connecticut	1982	232.7	116.7	0.0	1,754.1
	2015	165.0	103.0	0.0	1,592.7
	% Change	-29%	-12%	N/A	-9%
Delaware	1982	523.3	36.3	0.0	373.7

State	Year	Cropland	Pastureland	Non-Federal Rangeland	Non-Federal Forestland
	2015	398.9	39.5	0.0	346.7
	% Change	-24%	9%	N/A	-7%
Florida	1982	3,572.7	4,320.3	4,274.8	13,424.1
	2015	2,819.9	3,720.9	2,465.0	13,224.5
	% Change	-21%	-14%	-42%	-1%
Georgia	1982	6,599.1	2,952.2	0.0	22,056.7
	2015	4,403.6	2,604.2	0.0	21,796.7
	% Change	-33%	-12%	N/A	-1%
Idaho	1982	6,442.4	1,231.7	6,825.5	4,036.4
	2015	5,390.5	1,415.5	6,807.0	4,035.0
	% Change	-16%	15%	0%	0%
Illinois	1982	24,754.4	3,183.2	0.0	3,635.8
	2015	23,952.4	2,220.8	0.0	4,072.9
	% Change	-3%	-30%	N/A	12%
Indiana	1982	13,806.7	2,198.3	0.0	3,811.2
	2015	13,325.0	1,756.7	0.0	3,913.3
	% Change	-3%	-20%	N/A	3%
Iowa	1982	26,377.2	4,522.3	0.0	1,916.0
	2015	26,023.7	3,251.5	0.0	2,393.6
	% Change	-1%	-28%	N/A	25%
Kansas	1982	29,090.0	2,128.7	16,442.6	1,587.0
	2015	26,218.0	3,054.8	15,667.3	1,805.2
	% Change	-10%	44%	-5%	14%

State	Year	Cropland	Pastureland	Non-Federal Rangeland	Non-Federal Forestland
Kentucky	1982	5,933.1	5,920.8	0.0	10,541.4
	2015	5,661.5	4,691.5	0.0	10,809.7
	% Change	-5%	-21%	N/A	3%
Louisiana	1982	6,394.8	2,330.3	219.5	13,172.0
	2015	4,915.8	2,560.8	193.2	13,062.5
	% Change	-23%	10%	-12%	-1%
Maine	1982	520.7	308.9	0.0	17,596.0
	2015	368.3	171.3	0.0	17,514.4
	% Change	-29%	-45%	N/A	0%
Maryland	1982	1,769.7	546.2	0.0	2,425.9
	2015	1,422.4	407.2	0.0	2,313.4
	% Change	-20%	-25%	N/A	-5%
Massachusetts	1982	289.9	184.4	0.0	3,044.9
	2015	220.9	141.2	0.0	2,548.4
	% Change	-24%	-23%	N/A	-16%
Michigan	1982	9,387.9	2,930.7	0.0	15,921.1
	2015	7,990.9	2,187.6	0.0	16,673.7
	% Change	-15%	-25%	N/A	5%
Minnesota	1982	22,946.4	3,801.2	0.0	16,254.0
	2015	21,330.7	3,821.3	0.0	16,432.3
	% Change	-7%	1%	N/A	1%
Mississippi	1982	7,384.8	3,997.9	0.0	15,402.0
	2015	4,755.4	3,014.5	0.0	17,354.5

State	Year	Cropland	Pastureland	Non-Federal Rangeland	Non-Federal Forestland
	% Change	-36%	-25%	N/A	13%
Missouri	1982	14,927.9	12,431.8	125.4	11,509.9
	2015	14,816.4	9,689.1	65.2	12,635.6
	% Change	-1%	-22%	-48%	10%
Montana	1982	17,109.7	3,119.0	38,115.2	5,916.3
	2015	15,427.1	4,485.4	36,856.9	5,850.1
	% Change	-10%	44%	-3%	-1%
Nebraska	1982	20,287.9	1,949.0	23,598.7	861.6
	2015	20,164.0	1,925.7	22,842.9	834.1
	% Change	-1%	-1%	-3%	-3%
Nevada	1982	856.2	287.4	8,764.5	387.5
	2015	597.7	272.4	8,779.9	338.5
	% Change	-30%	-5%	0%	-13%
New Hampshire	1982	159.3	125.5	0.0	4,112.8
	2015	112.8	97.1	0.0	3,787.1
	% Change	-29%	-23%	N/A	-8%
New Jersey	1982	803.1	224.5	0.0	1,916.6
	2015	480.2	141.4	0.0	1,621.6
	% Change	-40%	-37%	N/A	-15%
New Mexico	1982	2,413.2	186.5	42,502.2	5,536.9
	2015	1,425.6	558.7	40,982.4	5,593.8
	% Change	-41%	200%	-4%	1%
New York	1982	5,855.3	3,850.5	0.0	16,584.9

State	Year	Cropland	Pastureland	Non-Federal Rangeland	Non-Federal Forestland
	2015	4,982.5	2,535.5	0.0	17,579.2
	% Change	-15%	-34%	N/A	6%
North Carolina	1982	6,703.8	1,964.9	0.0	17,150.5
	2015	5,079.4	1,972.5	0.0	15,672.9
	% Change	-24%	0%	N/A	-9%
North Dakota	1982	27,044.8	1,190.4	11,508.2	466.5
	2015	25,231.9	2,424.1	10,659.1	446.0
	% Change	-7%	104%	-7%	-4%
Ohio	1982	12,388.1	2,768.0	0.0	6,725.3
	2015	11,172.1	2,116.9	0.0	7,155.8
	% Change	-10%	-24%	N/A	6%
Oklahoma	1982	11,606.5	7,208.2	14,670.5	7,289.8
	2015	8,715.7	8,803.8	13,510.2	8,015.3
	% Change	-25%	22%	-8%	10%
Oregon	**1982**	**4,289.8**	**1,997.7**	**9,179.8**	**12,395.8**
	2015	**3,604.0**	**1,737.1**	**8,979.0**	**12,365.1**
	% Change	**-16%**	**-13%**	**-2%**	**0%**
Pennsylvania	1982	5,889.3	2,635.9	0.0	15,613.2
	2015	4,928.2	1,894.5	0.0	15,710.9
	% Change	-16%	-28%	N/A	1%
Rhode Island	1982	26.2	34.8	0.0	395.9
	2015	17.4	23.1	0.0	358.8
	% Change	-34%	-34%	N/A	-9%

State	Year	Cropland	Pastureland	Non-Federal Rangeland	Non-Federal Forestland
South Carolina	1982	3,526.7	1,195.8	0.0	11,361.4
	2015	2,133.8	1,113.2	0.0	11,248.9
	% Change	-39%	-7%	N/A	-1%
South Dakota	1982	17,103.1	2,676.3	23,202.5	571.3
	2015	18,008.2	2,181.6	22,141.6	553.5
	% Change	5%	-18%	-5%	-3%
Tennessee	1982	5,523.3	5,239.2	0.0	12,022.0
	2015	4,567.5	4,406.0	0.0	11,943.7
	% Change	-17%	-16%	N/A	-1%
Texas	1982	33,502.2	16,901.6	93,615.9	13,372.4
	2015	23,678.1	18,162.5	92,416.0	14,960.1
	% Change	-29%	7%	-1%	12%
Utah	1982	2003.5	531.3	11,073.8	2,221.0
	2015	1561.5	611.0	10,742.3	2,254.4
	% Change	-22%	15%	-3%	2%
Vermont	1982	644.1	441.6	0.0	4,140.0
	2015	525.7	330.5	0.0	4,057.2
	% Change	-18%	-25%	N/A	-2%
Virginia	1982	3,459.3	3,297.9	0.0	13,706.3
	2015	2,829.4	2,843.5	0.0	13,255.4
	% Change	-18%	-14%	N/A	-3%
Washington	1982	7,636.0	1,308.6	6,030.5	12,840.5
	2015	6,093.5	1,138.7	5,972.0	12,318.3

State	Year	Cropland	Pastureland	Non-Federal Rangeland	Non-Federal Forestland
	% Change	-20%	-13%	-1%	-4%
West Virginia	1982	1,080.7	1,878.0	0.0	10,370.5
	2015	644.9	1,431.5	0.0	10,513.6
	% Change	-40%	-24%	N/A	1%
Wisconsin	1982	11,477.1	3,523.8	0.0	14,278.9
	2015	10,338.4	2,985.9	0.0	14,815.9
	% Change	-10%	-15%	N/A	4%
Wyoming	1982	2,534.7	743.2	27,335.8	1,082.9
	2015	2,157.3	877.5	27,133.9	1,082.1
	% Change	-15%	18%	-1%	0%
All 48 Contiguous States	**1982**	**419,711.7**	**130,264.9**	**417,288.5**	**408,769.8**
	2015	**366,334.1**	**121,249.9**	**403,148.5**	**413,558.0**
	% Change	**-13%**	**-7%**	**-3%**	**1%**

Appendix G

Oregon Survey of 1,000 Likely Voters

Conducted October 28-29, 2019
By Pulse Opinion Research

1* The U.S. Department of Agriculture calculates that over the last three decades 656 square miles of farmland and natural habitat in Oregon have been permanently converted into housing, shopping malls, streets and other urban and suburban development. On balance, has this development made your state a better place to live, a worse place to live, or did it not have much effect?

16% A better place to live
49% A worse place to live
25% It did not have much effect
9% Not sure

2* Has Oregon developed too much, too little, or about as much as it should?

42% Too much
15% Too little
37% About as much as it should
6% Not sure

3* The state government projects that the population of Oregon will be 5.6 million in 2050, 1.6 million higher than in 2015. Will state and local governments keep most of that population growth inside current urban boundaries or will the growth lead to a lot more loss of farmland and natural habitat?

30% Most growth will be kept inside current urban boundaries
52% Growth will lead to a lot more loss of farmland and natural habitat
18% Not sure

4* If Oregon adds another 1.6 million people by 2050, is it more likely that traffic would become much worse or that the government will be able to build enough extra transportation capacity to accommodate the extra people?

81% Traffic would become much worse
14% The government will be able to build enough extra transportation capacity to accommodate the extra people
5% Not sure

5* Do you prefer that Oregon's towns and cities remain separate and distinct from each other and keep their own identities, or does it not matter much if they merge into larger, continuous urban areas?

70% Prefer towns and cities remain separate and distinct
23% It doesn't much matter if they merge into larger urban areas
7% Not sure

6* Thinking about agricultural land in Oregon, are you very concerned, somewhat concerned, not very concerned or not at all concerned about the ability to protect farmland from development?

45% Very concerned
36% Somewhat concerned
12% Not very concerned
3% Not at all concerned
3% Not sure

7* Is it unethical to pave over and build on good farmland or are the demands of a growing population a legitimate reason to pave over and build on farmland?

66% It is unethical to pave over and build on good farmland
19% The demand for more housing is a legitimate reason to pave over farmland
15% Not sure

8* How important is it to save the natural areas and open spaces that remain in Oregon?

71% Very important
22% Somewhat important
4% Not very important
1% Not at all important
2% Not sure

9* How important is it that you can easily spend time in natural areas near where you live?

70% Very important
24% Somewhat important
3% Not very important
1% Not at all important
1% Not sure

10* A study of government data found that most of the increased suburban development and the reduction of open spaces in Oregon in recent decades was related to population growth. Would you prefer that Oregon's population continue to grow at the recent rapid rate, that it grow much more slowly, that it stop growing, or that it become smaller?

13% Prefer Oregon's population grow at recent rapid rate
48% Grow much more slowly
20% Stop growing
12% Become smaller
7% Not sure

11* U.S. Census data show that about 30% of population growth in Oregon in the most recent decade is from new immigrants and births to immigrants. Should the federal government reduce future immigration to slow down population growth, keep future immigration and population growth at the current rate, or increase annual immigration and population growth?

46% Reduce future immigration to slow down population growth in Oregon
33% Keep future immigration and population growth at current rate
11% Increase immigration and population growth
10% Not sure

12* Another major source of Oregon's population growth is people moving in from other states. Should local and state governments in Oregon make it more difficult for people to move to Oregon from other states by restricting development?

41% Yes
41% No
18% Not sure

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

14* Do you live in a rural area, a town, a small city, the suburbs or in a big city?

29% Rural
17% Town
20% Small city
18% Suburbs
14% Big city
1% Not sure

15* Where would you prefer to live… in a rural area, a town, a small city, the suburbs or in a big city?

38% Rural
17% Town
19% Small city
12% Suburbs
10% Big city
3% Not sure

16* Have you lived in Oregon since childhood or did you move to Oregon as an adult?

61% Since childhood
38% Moved as an adult
1% Not sure

17* (Asked only of those who moved to Oregon as an adult – 380 voters) How long have you lived in Oregon, less than 5 years, 5-20 years, more than 20 years?

11% Less than 5 years
41% 5-20 years
48% More than 20 years
0% Not sure

18* (Asked only of those who moved to Oregon as an adult – 380 voters) Were you born in the United States?

89% Yes
11% No

19* (Asked only of those who moved to Oregon as an adult and were not born in the US – 42 Voters) What brought you to the United States, employment, education, or were you a refugee?

27% Employment

39% Education
16% Refugee or asylee
18% Something else
0% Not sure

20* (Asked only of those who moved to Oregon as an adult and were not born in the US – 42 Voters) Was Oregon your first state of residence when you moved to the United States?

43% Yes
57% No

21* (Asked only of those who moved to Oregon as an adult – 380 voters) Did you move to Oregon from California, from some other Western State, from the Midwest, from the South or from the East?

30% California
28% Some other Western state
23% The Midwest
6% The South
11% The East
2% Not sure

22* (Asked only of those who moved to Oregon as an adult – 380 voters) What was the major factor in your decision to live in Oregon . . . a job opportunity, decided to stay after attending school, or seeking a better quality of life?

31% Job opportunity in the state
7% Decided to stay after attending from school
44% Seeking a better quality of life
17% Some other reason
1% Not sure

NOTE: Margin of Sampling Error, +/- 3 percentage points with a 95% level of confidence, except questions 17, 18, 21 & 22 which have a margin of sampling error of +/-5% and question 19 & 20 which have a sampling error of +/- 15%.

Appendix H

2014 National Poll on Sprawl and Population

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

70% Yes
18% No
12% Not sure

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix I

Side-by-Side Comparison of Similar Questions in 2019 Oregon, 2015 Southern Piedmont, and 2014 National Surveys of Likely Voters About Sprawl-Related Issues

2019 Oregon Survey of 1,000 Likely Voters	2015 Piedmont Poll on Sprawl and Population (2,500 Adults)	2014 National Poll on Sprawl and Population (1,000 Likely Voters)
The U.S. Department of Agriculture calculates that over the last three decades 656 square miles of farmland and natural habitat in Oregon have been permanently converted into housing, shopping malls, streets and other urban and suburban development. On balance, has this development made your state a better place to live, a worse place to live, or did it not have much effect? • 16% A better place to live • 49% A worse place to live • 25% It did not have much effect • 9% Not sure	On balance, has the development of the Piedmont made your region a better place to live, a worse place to live or did it not have much effect? • 28% Better • 30% Worse • 33% Did not have much of an effect • 8% Not sure	
Has Oregon developed too much, too little, or about as much as it should? • 42% Too much • 15% Too little • 37% About as much as it should • 6% Not sure	Has your Piedmont region developed too much, too little or about as much as it should? • 29% Too much • 14% Too little • 48% About as much as it should • 8% Not sure	

2019 Oregon Survey of 1,000 Likely Voters	2015 Piedmont Poll on Sprawl and Population (2,500 Adults)	2014 National Poll on Sprawl and Population (1,000 Likely Voters)
If Oregon adds another 1.6 million people by 2050, is it more likely that traffic would become much worse or that the government will be able to build enough extra transportation capacity to accommodate the extra people? • 81% Traffic would become much worse • 14% The government will be able to build enough extra transportation capacity to accommodate the extra people • 5% Not sure	Have governments been able to provide the roads and transportation systems to handle the extra population in the Piedmont region well, or has traffic become worse? • 23% New roads and transportation have handled extra population well • 66% Traffic has become worse • 11% Not sure	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
Do you prefer that Oregon's towns and cities remain separate and distinct from each other and keep their own identities, or does it not matter much if they merge into larger, continuous urban areas? • 70% Prefer towns and cities remain separate and distinct • 23% It doesn't much matter if they merge into larger urban areas • 7% Not sure	Do you prefer that the Piedmont's towns and small cities remain separated from each other and keep their own identity or does it not matter too much if they are absorbed by larger cities? • 76% Prefer towns and small cities remain separate and with own identity • 17% It doesn't much matter if they are absorbed by larger cities • 7% Not sure	

2019 Oregon Survey of 1,000 Likely Voters	2015 Piedmont Poll on Sprawl and Population (2,500 Adults)	2014 National Poll on Sprawl and Population (1,000 Likely Voters)
Thinking about agricultural land in Oregon, are you very concerned, somewhat concerned, not very concerned or not at all concerned about the ability to protect farmland from development? • 45% Very concerned • 36% Somewhat concerned • 12% Not very concerned • 3% Not at all concerned • 3% Not sure	How concerned are you about the ability to protect farmland from development in the Piedmont region? • 44% Very concerned • 36% Somewhat concerned • 14% Not very concerned • 3% Not sure	
Is it unethical to pave over and build on good farmland or are the demands of a growing population a legitimate reason to pave over and build on farmland? • 66% It is unethical to pave over and build on good farmland • 19% The demand for more housing is a legitimate reason to pave over farmland • 15% Not sure	Is it unethical to pave over and build on good farmland or is the demand for more housing for a growing population a legitimate reason to pave over and build on farmland? • 64% It is unethical to pave over and build on good farmland • 19% The demand for more housing is a legitimate reason to pave over farmland • 18% Not sure	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

2019 Oregon Survey of 1,000 Likely Voters	2015 Piedmont Poll on Sprawl and Population (2,500 Adults)	2014 National Poll on Sprawl and Population (1,000 Likely Voters)
How important is it to save the natural areas and open spaces that remain in Oregon? • 71% Very important • 22% Somewhat important • 4% Not very important • 1% Not at all important • 2% Not sure	How important is it to save the natural areas and open spaces that are currently between the cities of your Piedmont region? • 61% Very important • 27% Somewhat important • 6% Not very important • 1% Not at all important • 4% Not sure	
A study of government data found that most of the increased suburban development and the reduction of open spaces in Oregon in recent decades was related to population growth. Would you prefer that Oregon's population continue to grow at the recent rapid rate, that it grow much more slowly, that it stop growing, or that it become smaller? • 13% Prefer Oregon's population grow at recent rapid rate • 48% Grow much more slowly • 20% Stop growing • 12% Become smaller • 7% Not sure	Would you prefer that the Piedmont's population continue to grow at the recent rapid rate, that it grow much more slowly, that it stay about the same size as it is now, or that it become smaller? • 13% Prefer the Piedmont's population grow at recent rapid rate • 48% Grow much more slowly • 25% Stay about the same size as it is now • 9% Become smaller • 5% Not sure	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

2019 Oregon Survey of 1,000 Likely Voters	2015 Piedmont Poll on Sprawl and Population (2,500 Adults)	2014 National Poll on Sprawl and Population (1,000 Likely Voters)
U.S. Census data show that about 30% of population growth in Oregon in the most recent decade is from new immigrants and births to immigrants. Should the federal government reduce future immigration to slow down population growth, keep future immigration and population growth at the current rate, or increase annual immigration and population growth? • 46% Reduce future immigration to slow down population growth in Oregon • 33% Keep future immigration and population growth at current rate • 11% Increase immigration and population growth • 10% Not sure	Should the federal government reduce new immigration to slow down population growth, keep new immigration and population growth at the current rate, or increase annual immigration and population growth? • 60% Reduce new immigration to slow down Piedmont population growth • 26% Keep new immigration and population growth at current rate • 5% Increase immigration and population growth • 9% Not sure	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

2019 Oregon Survey of 1,000 Likely Voters	2015 Piedmont Poll on Sprawl and Population (2,500 Adults)	2014 National Poll on Sprawl and Population (1,000 Likely Voters)
Another major source of Oregon's population growth is people moving in from other states. Should local and state governments in Oregon make it more difficult for people to move to Oregon from other states by restricting development? • 41% Yes • 41% No • 18% Not sure	Should local and state governments in the Piedmont make it more difficult for people to move to the region by restricting development? • 30% Yes • 52% No • 18% Not sure	
Do you live in a rural area, a town, a small city, the suburbs or in a big city? • 29% Rural • 17% Town • 20% Small city • 18% Suburbs • 14% Big city • 1% Not sure	Do you live in a rural area, a town, a small city, the suburbs or in a big city? • 27% Rural • 17% Town • 20% Small city • 21% Suburbs • 8% Big city • 3% Not sure	

2019 Oregon Survey of 1,000 Likely Voters	2015 Piedmont Poll on Sprawl and Population (2,500 Adults)	2014 National Poll on Sprawl and Population (1,000 Likely Voters)
Where would you prefer to live… in a rural area, a town, a small city, the suburbs or in a big city? • 38% Rural • 17% Town • 19% Small city • 12% Suburbs • 10% Big city • 3% Not sure	Where would you prefer to live? • 32% Rural • 17% Town • 20% Small city • 27% Suburbs • 8% Big city • 1% Not sure	

Appendix J

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

Urban Planning Oversight

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

Statistical Oversight

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

Continued on next page

***** The individuals on this list volunteered to provide advice and guidance to the 2001 Kolankiewicz-Beck sprawl study for NumbersUSA and to have their names listed prominently as Advisors inside the front cover. Their advice and affirmations formed the foundation methodology for all succeeding studies, including this one.

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, a*ttorney, civil engineer*
Jeffrey Jacobs, *Ph.D.,* National Academy of Sciences
John Bermingham, *former Colorado state senator*
John Rohe, *attorney; board, Conservation News Service*
Linda Thom, *retired government budget analyst, Santa Barbara County (CA)*
Michael Hanauer, *member, Vision 2020, growth management project of Lexington (MA)*
Ross McCluney, *Ph.D., principal research scientist, Florida Solar Energy Center,* University of Central Florida
Steve Miller, *former Las Vegas councilman, Clark County (NV) Regional Transportation Commissioner*
Stuart Hurlbert, *Ph.D., professor of biology,* San Diego State University
Terry Paulson, *Mayor Pro-tem, Aspen (CO) City Council*
Tom Reitter, *Livermore (CA) City Council*