THE FISCAL IMPLICATIONS OF DEVELOPMENT PATTERNS

Pagosa Springs, Colorado

April 2017

Prepared for the
Town of Pagosa Springs

Table of Contents

Background and Objectives

The connection between land use development patterns and the costs of providing public infrastructure and services has long been a topic of study, particularly since *The Cost of Sprawl: A Detailed Analysis* was published in 1974. Since that time, dozens – if not hundreds – of studies have been conducted related to this topic. Most of these have concluded that "smart growth" – more compact patterns of development – is associated with reduced local government spending on a per capita basis relative to sprawl (recognizing that the definition of each of these terms is not entirely consistent). Smart Growth America's *Building Better Budgets* report, published in May 2013, summarizes the results of 17 of these studies.

> *The Cost of Sprawl*, published by the Real Estate Research Corporation in 1974, was the first study to show that providing infrastructure to low-density, sprawling development costs more than for compact developments. Low-density development's greater distances among homes, offices, shops, etc., require more road and utility infrastructure than would be required to serve the same number of homes and businesses in a more compact development pattern. Looked at another way, one mile of infrastructure costs roughly the same to build no matter where it is, but that mile can serve many times more people in a high-density place than in a low-density place.

Yet these findings are not often included in the typical fiscal impact analysis done in connection with new development proposals. There are many reasons for this, but the inconsistent methodologies used in the above referenced studies, as well as the time-consuming data collection efforts they involve, have likely slowed the filtering of these advanced academic findings into "practice." Instead, most, (though not all) fiscal impact analyses rely on a simple average cost approach, which implicitly assumes that each new resident or job will add the same amount of public costs, regardless of whether they live and work in a sprawling, low-density development, or a high-density, walkable urban one.

As part of a U.S. Department of Agriculture Rural Development program grant, Smart Growth America ("SGA") aims to apply our fiscal impact methodology that accounts for the increased cost efficiencies associated with denser development patterns. This report applies our fiscal impact methodology to the Town of Pagosa Springs, Colorado.

This analysis considers how Pagosa Springs might accommodate a forecasted 601 new housing units for residents and seasonal rentals over the next 20 years (by 2036). Density matters in terms of what new growth would cost the town.

We assessed four scenarios:

1) A Baseline scenario with growth at the existing average densities of 0.23 units per acre.
2) Alternative A, which uses a density of 2.3 units per acre. This density level equates to the 95th percentile density observed in the town by this analysis.
3) Alternative B, which uses a density of 5 units per acre, which equates to the level at which the revenues generated at this density nearly offset the development costs measured.

4) Alternative C, which also uses 5 units per acre, but does so at a mix of 50 percent infill and 50 percent greenfield development.

Under the Baseline Scenario, the Town would face a 20-year cost of $97.50 million in providing additional infrastructure to accommodate the new growth. The most aggressive alternative, Alternative C, costs substantially less, $7.70 million over 20 years. This represents a potential savings of $86.10 million.

The cost savings are the result of reduced roadway, sidewalk, fire hydrant, and water system costs at higher densities and infill development. When we consider the average tax revenues of the new residents, Alternative C results in a *positive net fiscal impact* of $ 0.60 million per year.

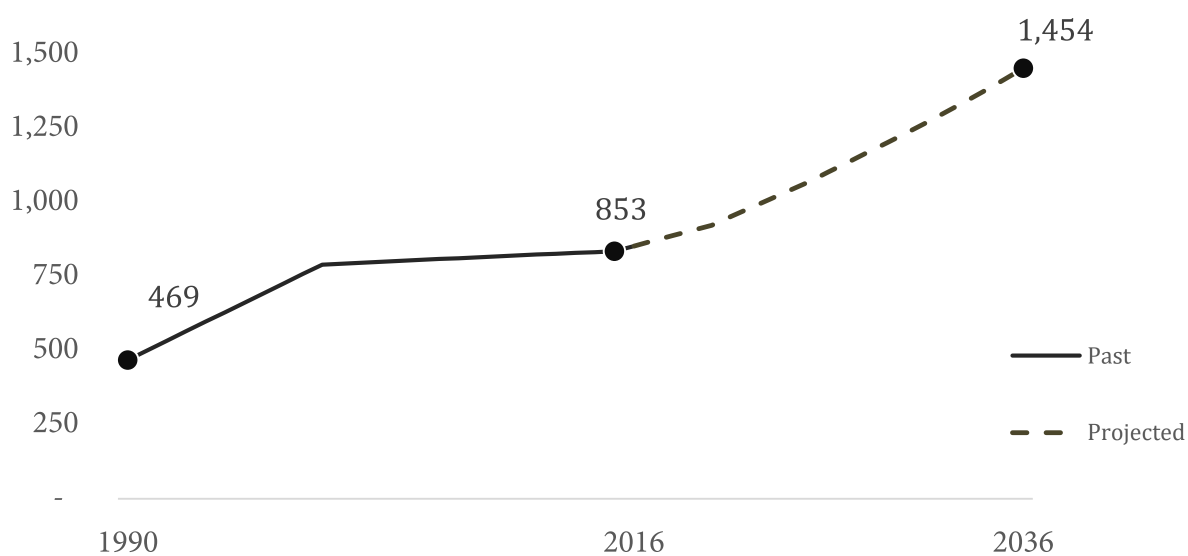
Pagosa Springs Projected Growth

While the number of housing units (both primary households, and seasonal homes) in Pagosa Springs remained relatively stable during the early 2000s, the number of households and seasonal homes are projected to increase steadily over the next 20 years. We applied county level population forecasts from the Colorado State Demography Office[i] and forecasted a 77 percent increase by 2036 (2.7 percent annually). The percentage of annual growth was translated from population into housing units for this analysis. Figure 1 and Table 1 below illustrate the assumed growth rates we used for this analysis.

With significant growth on the horizon for Pagosa Springs, this fiscal impact analysis seeks to address the question, “What will it cost to accommodate an additional 601 housing units?” As our approach suggests, the answer depends on choices the community makes about density.

Figure 1

Pagosa Springs, CO Housing Units and Forecast (2016 +)



Source: U.S. Decennial Census 1990, 2000, 2010, ACS 2016 5-Year Community Survey, Colorado State Demography Office

TABLE 1

	2016	2026	2036	Change 2016 to 2036
Housing	853	1,103	1,454	601

Source: ACS 2016 5-Year Community Survey, Colorado State Demography Office

Development Scenarios

SGA worked together with the Town of Pagosa Springs to develop alternative development scenarios. The development of these scenarios considered factors such as existing density levels and plausible future densities. We then used geographic information systems (GIS) analysis to divide the Town into equal 25-acre cells, and to identify the total number of households, and total number of seasonal or second homes of each cell based on U.S. Census data.[ii]

Pagosa Springs Key Stats

0.23 units / acre
AVERAGE DENSITY OF HOUSING UNITS

2.10 persons / hh
AVERAGE HOUSEHOLD SIZE

2.3 units / acre
ALTERNATIVE A DEVELOPMENT DENSITY

5.0 units / acre
ALTERNATIVE B & C DEVELOPMENT DENSITY

Because Pagosa Springs is also a location of high demand of vacation and seasonal homes, the approach for measuring the population has been adjusted to account for seasonal housing. The unit of measurement for the population in this analysis is conducted per housing unit. Housing units include the total of primary households reported on the U.S. Census, as well as any homes identified in the Census as secondary, season, or recreational.

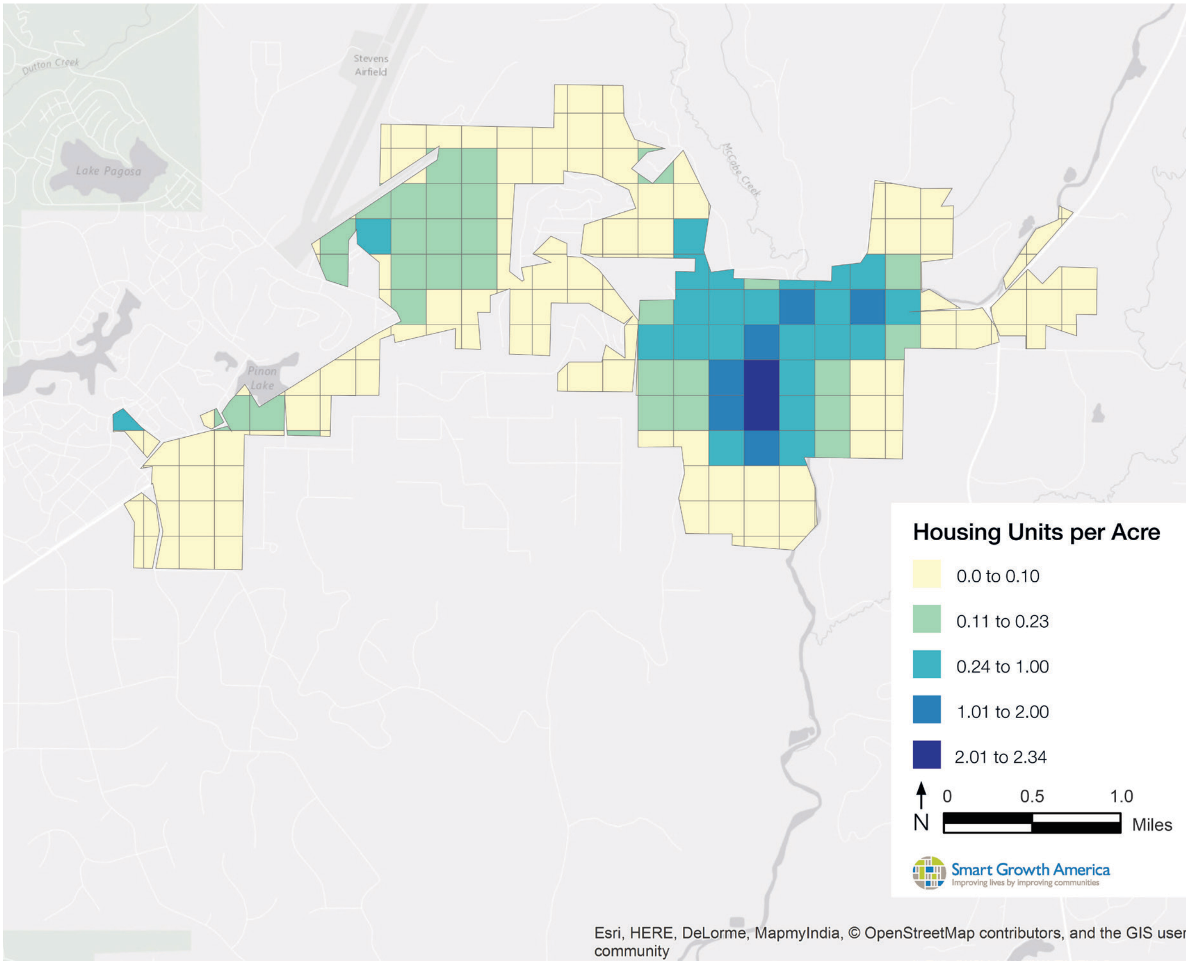
Based on the GIS analysis, and accounting for unbuildable areas of steep slope (greater than 25 percent) as well as areas without any population, the existing average density across the entire Town of Pagosa Springs is 0.23 housing units per acre (or average lot sizes greater than 4 acres). At Pagosa Springs's average household size of 2.10 people per household, this equates to 0.5 persons per acre.

Higher densities were observed within isolated areas of Pagosa Springs, such as, that reached levels of about 5 housing units per acre. The average density level is much lower primarily due to very low-density development within the Town limits, especially in more rural areas. Areas with a population density lower than 0.10 people per acre were excluded from average density calculations.

Figure 2 illustrates the densities across the various analysis cells in Pagosa Springs. As seen, the highest housing densities exist along South 7th Street in isolated areas of compact development. Overall the highest densities observed within an entire 25-acre grid cell were only 2.3 units per acre.

FIGURE 2

Pagosa Springs Population Density, 2010



Source: Smart Growth America, 2017; U.S. Decennial Census, 2010

This analysis assesses three potential development scenarios to accommodate the additional 601 residential and seasonal housing units.

1. The Baseline Scenario assumes that new development would continue at the existing average density of 0.23 housing units per acre. This equates to a residential density of 0.5 persons per acre.
2. Alternative A represents new growth occurring at an average of 2.3 units per acre. This represents about 4.8 persons per acre.
3. Alternative B represents new development at 5 households per acre. This represents about 11 persons per acre.
4. Alternative C, which also uses 5 units per acre, but does so at a mix of 50 percent infill and 50 percent greenfield development.

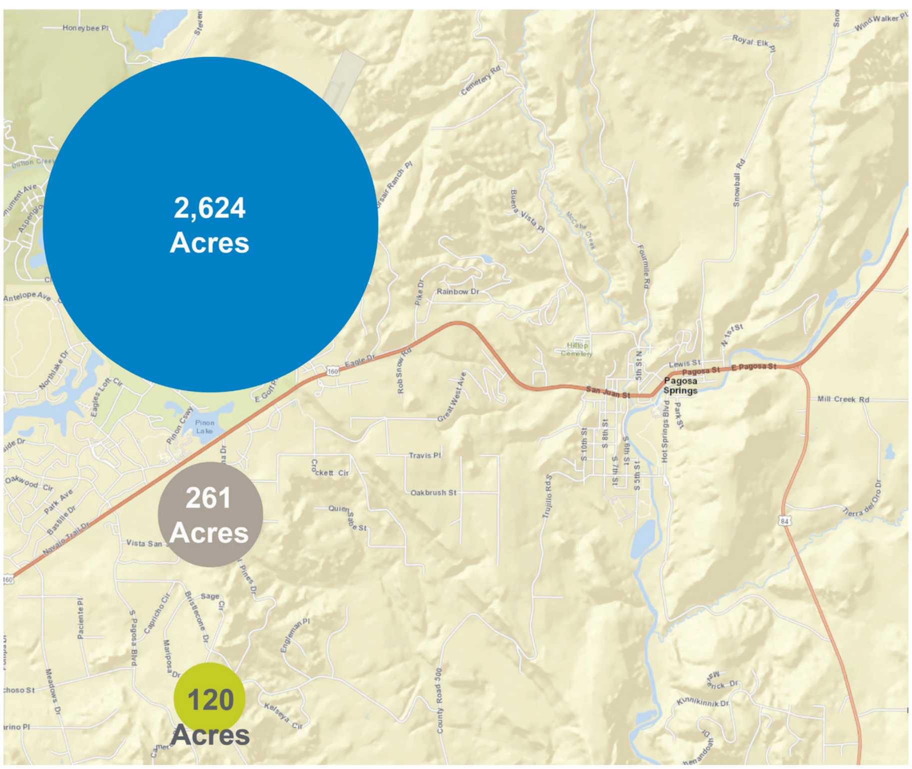
TABLE 2
Pagosa Springs, Colorado Density Alternatives

	Baseline	Alternative A	Alternative B	Alternative C
Housing Units per Acre	0.23	2.3	5	5
Total Gross Acres	2,624	261	120	120

Source: Smart Growth America, 2017

Accommodating the new residents and jobs at these density levels would lead to vastly different physical footprints. The Baseline Scenario would require 2,624 acres of development; Alternative A would require 261 acres and Alternatives B & C would require 120 acres as illustrated in Figure 3.

FIGURE 3
Area Requirements of Analysis Scenarios, Pagosa Springs, Colorado



Source: Smart Growth America, 2017

Methodology

Infrastructure items considered:

- ROADS
- SIDEWALKS
- WATER LINES
- FIRE HYDRANTS

This analysis focuses on four expenditure types for the Town of Pagosa Springs: roads, sidewalks, water lines, and fire hydrants. We selected these items based on the available data from the Town of Pagosa Springs and Archuleta County, and we consider these items for sketch planning purposes. There are many other infrastructure costs, such as police and fire services, schools, and civic infrastructure that are also part of planning for population growth. Focusing on only these five items narrows in on costs that have the strongest relationship to population densities, which can be estimated given the sketch level planning scenarios. **Because this analysis does not use all possible infrastructure items, the costs we present are likely a conservative estimate of what future development would actually cost the Town.**

For each expenditure item, the Town of Pagosa Springs provided appropriate GIS shapefiles. Using this data, we applied those infrastructure items to the 25-acre cell grid, and this process allowed us to calculate unit density (e.g. "roads per acre").

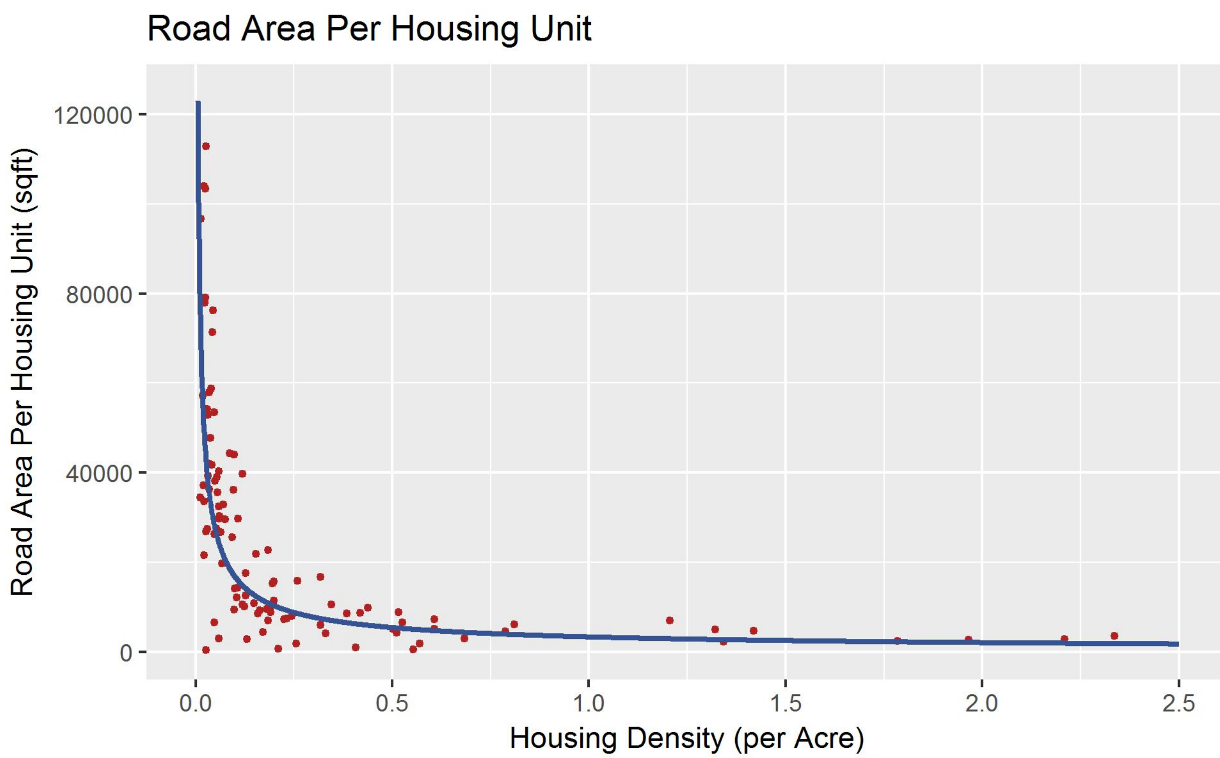
We then applied estimates of units per acre, for each infrastructure item, as the basis of an ordinary least squares ("OLS") regression analysis. In creating the data set, the unit of analysis was the 25-acre cell. The result is a set of models that estimates unit density (e.g. "roads per acre") as a function of population density (e.g. "people or housing units per acre"). Population density for Pagosa Springs is represented by the total number of primary households as well as secondary or seasonal homes as reported in the U.S. Decennial Census. These models allow one to estimate the amount of infrastructure units needed per housing unit as a function of density. (This operation distinguishes this analysis from "average cost analyses" more commonly used in fiscal impact modeling, as described above on page 3.)

Take Table 3 as an example, which illustrates how "road area per housing unit" sharply decreases as a function of population density. At very low levels of population there are thousands of square feet of road needed per housing unit. At higher density this decreases to levels of less than 1,000 and even less than 500 square feet per housing unit because roads can be shared and distributed among more households.

This scatter plot is the basis of the regression analysis. We created unique models for each infrastructure item, with each item exhibiting a similar relationship. The scatter plots, resulting regression outputs, and cost itemization are reported in Appendix A.

TABLE 3

Road Area per Capita, by Density (Pagosa Springs, CO)



Source: Smart Growth America, 2017

Each model estimates the quantity needed per capita, and then the total quantity of infrastructure needed. Using those total quantities, we used item-specific cost factors, each of which was developed based on SGA research and coordination with the Town of Pagosa Springs.

The final step in this analysis was to add two additional costs: the costs of financing, and operations and maintenance costs. Infrastructure items are long-term capital investments, and governments typically issue bonds to pay for these investments. This analysis assumes that the financing cost to the Town would be 2.2 percent interest over 20-years (a typical cost of long-term municipal bonds in 2016). Finally, the analysis adds operations and maintenance cost of 5 percent.[iii]

Results

There are two key results from this analysis. The first are the total 20-year costs, which are the total costs that our fiscal impact model estimated. For a sense of scale we report the results on a per-year basis (Table 4).

The second result is what we call *net fiscal impact* (Table 5). The net fiscal impact takes the total 20-year cost, and compares it against potential revenues of new households. Here, we use an average revenue based on the Town's 2017 budget of $3,517 per housing unit. The three scenarios all plan for the same level of growth, therefore they each would generate the same revenues. The only change among the scenarios is on the cost side. When we compare the revenues against the costs, the difference is the net fiscal impact. A negative net fiscal impact indicates that the Town would lose money in accommodating the new growth; a positive net fiscal impact indicates that the Town would actually make net revenues.

The results of this analysis (Table 4) show that the Baseline scenario would cost the Town $97.50 million over 20 years. This equates to $4.88 million per year, equivalent to 45 percent of the Town's 2017 proposed total budget.[iv] Applying the estimated potential tax revenues from new housing units yields a 20-year net fiscal impact of -$77.86 million, or -$3.89 million per year (Table 5).

Alternative A, which assumes a density of 2.3 households per acre, the highest density observed over a 25-acre grid cell. This development pattern would reduce the 20-year costs to $19.58 million ($0.98 million per year). The net fiscal impact is almost cost-neutral: a 20-year net fiscal impact of +$0.07 million (nearly $0 per year).

Alternative B uses a higher density pattern of 5.0 households per acre built on 100% greenfield development, which was observed in specific sub-developments within the Town. We estimate 20-year costs for this development pattern at $11.41 million ($0.57 million per year). This scenario shows where the Town would be "in the black" and make more estimated revenues than it would pay in infrastructure costs. The 20-year net fiscal impact is +$8.24 million (+$0.41 million per year).

Alternative C is similar to Alternative B but adds an assumption that 50 percent of development occurs as infill. By exploiting existing infrastructure through infill development, this scenario substantially reduces costs. We estimate 20-year costs at $7.70 million ($0.39 million per year). Pagosa Springs would continue to make more estimated revenues than it would pay in infrastructure costs. The 20-year net fiscal impact is +$11.95 million (+$0.60 million per year).

The density level of 5.0 households per acre is important because it is a density at which the additional costs of infrastructure are offset by potential revenues. At lower density levels (such as the Baseline density of 0.23 households per acre), the Town would likely have a *negative* net fiscal impact. It is at 2.3 households per acre where we see an almost cost-neutral net fiscal impact (Alternative A); and by increasing the density of development further (Alternative B), the Town reduces costs beyond the break-even point of incoming revenues, creating a *positive* net fiscal impact. By adding infill development (Alternative C), the Town reduces costs even further, increasing its positive net fiscal impact.

TABLE 4

Results – Pagosa Springs Development Costs in Summary

(Millions $)	Baseline	Alternative A	Alternative B	Alternative C
Capital Costs – 20 years	$75.19	$15.10	$8.80	$5.94
Amortized Costs (20 years at 2.2% rate)	$93.75	$18.82	$11.00	$7.40
Maintenance Costs – 20 years	$3.76	$0.75	$0.44	$0.30
Total Costs – 20 years	$97.50	$19.58	$11.41	$7.70
Total Costs per Year	$4.88 (+34% to budget)	$0.98 (+6.8% to budget)	$0.57 (+4.0% to budget)	$0.39 (+2.7% to budget)

Source: Smart Growth America, 2017

TABLE 5

Results – Pagosa Springs Development Net Fiscal Impact

(Millions $)	*Baseline*	*Alternative A*	*Alternative B*	*Alternative C*
Total Costs – 20 Years	$97.50	$19.58	$11.40	$7.70
Est. Tax Revenue -20 Years	$19.65	$19.65	$19.65	$19.65
Net Fiscal Impact – 20 Years	-$77.86	+$0.07	+$8.24	+$11.95
Total Costs – Annual	$4.88	$0.98	$0.57	$0.39
Est. Tax Revenue – Annual	$0.98	$0.98	$0.98	$0.98
Net Fiscal Impact – Annual	-$3.89	+$0.00	+$0.41	+$0.60

Source: Smart Growth America, 2017

Another way of looking at costs is to consider the marginal costs per new resident or household. This measure tells us, on the average, how much each new housing unit costs the Town in terms of infrastructure. Under the Baseline Scenario, each new unit would cost the Town $8,123 per year. This compares to $1,631 annually per housing unit under Alternative A; $950 annually per unit in Alternative B, and $641 annually per unit in Alternative C (Table 6).

TABLE 6

Results – Pagosa Springs Development Costs per Capita (Marginal Costs)

	Baseline	*Alternative A*	*Alternative B*	*Alternative C*
Total 20-year Costs per Additional Housing Unit	$162,457	$32,618	$19,007	$12,830
Annual Costs per Additional Housing Unit	$8,123	$1,631	$950	$641

Source: Smart Growth America, 2017

The bottom row of Table 6 simply compares the annual and yearly costs associated with the development of each new housing unit under each scenario. One way of interpreting these numbers is to think of them in terms of how much each household would have to pay the Town to "break even" in terms of infrastructure. The Baseline Scenario would cost the Town $8,123 annually for each new household; $1,631 annually for each new household under Alternative A; $950 annually for each new household under Alternative B; and $641 annually for each new household under Alternative C.

Alternatives A, B and C represent noteworthy points for a revenue analysis, and it brings us back to what we observe for net fiscal impacts. Recall that the net fiscal impact calculations used the 2017 town budget's average revenues of $3,517 per household. This tells us that Alternatives A, B, and C have a marginal cost per resident *less* than the expected marginal revenues – a positive net revenue for the town.

These marginal costs result differ from the net fiscal impact because they do not consider the fact that new residents do not arrive all at once, and the net fiscal impact calculations do. When the revenues trickle in year-over-year, Alternative A is nearly neutral for net fiscal impact (+$3,542 annually), and Alternatives B and C have a positive net fiscal impact (+$411,988 and +$597,370 annually respectively).

This analysis tells us that ***development at existing average density levels would cost the Town more money – just for the infrastructure items included in this study – than the Town would likely receive in additional revenues.*** The costs are amplified when we consider the comprehensive set of infrastructure items. However, this is a simplified analysis for sketch planning purposes.

Revenues per household in these scenarios are likely to be lower than those shown here because most of the additional revenue to the Town would be in the form of various taxes. This means that even higher levels of density would be necessary to have "cost neutral growth."

The net fiscal impact results underscore the notion that the new growth would create a cost to the Town if future development continues to build at existing densities. Those additional costs would have to be made up somewhere. For example, under the Baseline Scenario, the Town would have to generate $8,123 annually from each new household for the household to pay its own marginal costs. Hypothetically, the Town could tax these new households $8,123 per year, but we know that is unlikely. What is more likely is that the costs would distributed among the existing residents and businesses. The Town could also depend on external funds or state funds to pay for the costs, but the point remains that these revenues would have to be generated from somewhere.

Finally, we convert the costs into "cost savings" relative to the Baseline Scenario (Table 7). Using this point of view, Alternatives A, B, and C offer significant potential savings to the Town compared to the Baseline. Alternative A would save the Town $77.93 million over 20 years ($3.90 million per year), while Alternative B would save the Town $86.10 million over 20 years ($4.30 million per year) and Alternative C would save the Town $89.8 million over 20 years ($4.50 million per year).

TABLE 7

Results – Pagosa Springs Development Cost Savings

(Millions $)	*Baseline*	*Alternative A*	*Alternative B*	*Alternative C*
Total 20-year savings	-	$77.93	$86.10	$89.80
Savings per year	-	$3.90	$4.30	$4.50

Source: Smart Growth America, 2017

Conclusion

This analysis considers how Pagosa Springs might accommodate 601 additional housing units over the next 20 years (by 2036). The type of density matters in terms of what it would cost the Town to provide services to the additional households.

The Town could accommodate new growth at existing average densities of 0.23 housing units per acre and do so at a cost of infrastructure provision of $97.50 million over twenty years, or a net fiscal impact of -$77.86 million after considering potential tax revenues of new residents.

An alternative scenario (Alternative A), which uses a density that is among the highest already observed in the Town across a 25-acre grid cell, would cost $19.58 million over the same period, or a 20-year savings $77.93 million. The 20-year net fiscal impact is +$0.07 million.

A third scenario (Alternative B), uses higher densities as observed in select sub-developments. This scenario would cost $11.41 million over the same 20-year period, or a 20-year savings of $86.10 million. At this point the Town is “in the black,” with a 20-year net fiscal impact of +$8.24 million.

A fourth and final scenario (Alternative C), uses the same density as the previous scenario, but does so using 50 percent infill development. This scenario would cost $7.70 million over the same 20-year period, or a 20-year savings $89.80 million. At this point the City increases its net fiscal gains with a 20-year net fiscal impact of +$11.95 million.

In short, accommodating growth at higher density levels at about 5.0 households per acre would save the Town in the form of reduced roadway, sidewalk, fire hydrant, and water system infrastructure costs. Accommodating development at this density would result in a *positive* net fiscal impact to the town.

This is a set of hypothetical scenarios for the Town of Pagosa Springs, with assumed population forecasts. However, it highlights the financial consequences of land-use decisions over the long term. The costs of low-density, sprawling development add up to significant amounts over time. Planners and policymakers in the region will want to take note, before another 50 years of development makes the problem even worse. Smarter growth, with more compact development patterns, would reduce long-term costs.

The costs revealed in the fiscal impact analysis include both installation and ongoing maintenance costs for the next 20 years. Even though certain initial capital costs may be paid by the private sector, once accepted by the town or special district, the public will pay the ongoing maintenance costs over the 20-year horizon – and for the life of the infrastructure plus its eventual replacement.

The maintenance costs are the number to focus on in understanding the analysis. Pagosa Springs provided the necessary data for the analysis of costs for roads, sidewalks, water lines, and fire hydrant. However, to fully capture the ongoing costs, one would have to take into account additional costs such as school bus service, additional garbage collection, police,and fire protection and stormwater (for which Pagosa Springs had no data available for analysis). The exclusion of these additional costs renders our analysis very conservative and yet it still shows a significant savings from pursuing a more compact development as seen in many places within downtown Pagosa. Any cost savings shown in the analysis would only be multiplied if the additional unavailable data were included.

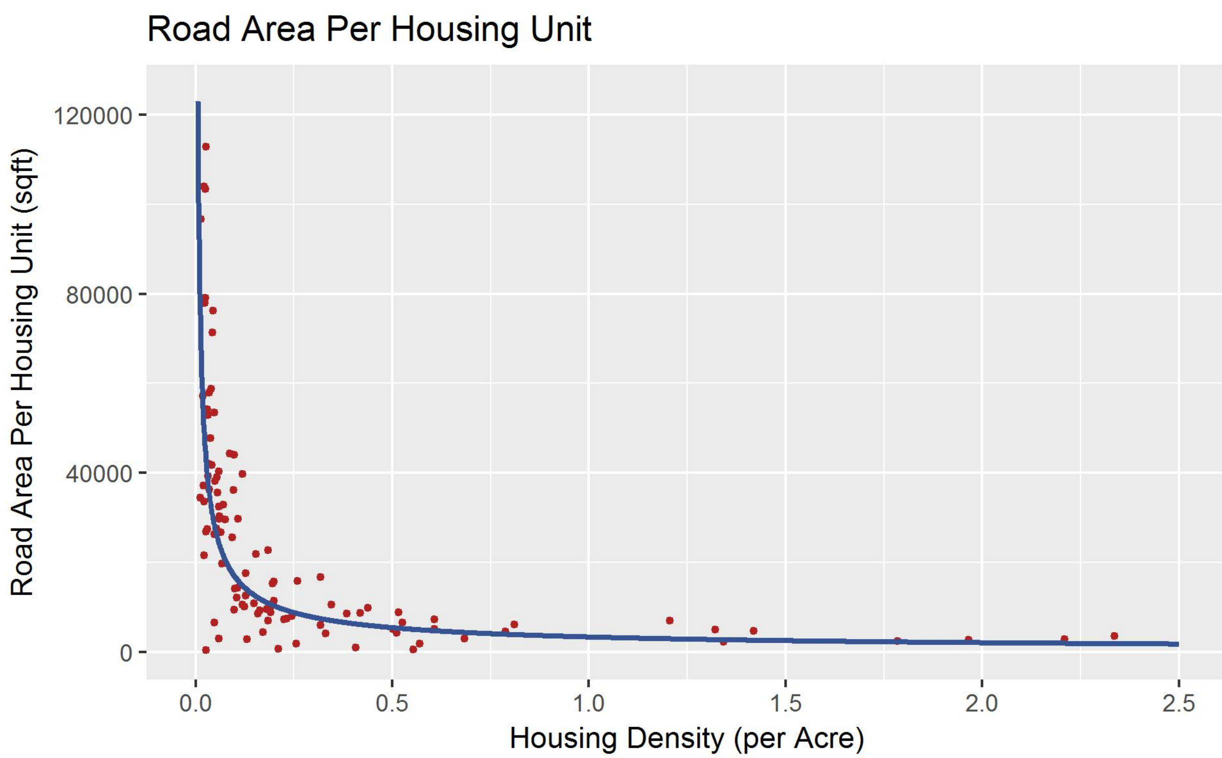
A few caveats to this analysis are warranted. First, because the population forecast assumes a projection of a population increase of 77 percent over 20 years, the magnitude of the numbers can vary. This is also the case with the development scenarios, which are hypothetical scenarios for density levels for the new growth. An analysis of a specific scenario or development pattern, especially with a defined geography would allow for assessment of other factors such as the costs of fixed services like schools, fire, police, waste management, and transit.

Finally, SGA conducted this analysis for the Town of Pagosa Springs using data particular to that community. These factors and magnitudes differ from community to community, representing the various policy and spending decisions that differ across the country. Infrastructure provision, especially on a per-capita basis, can vary widely from one place to another, even at similar density levels. Thus, it is best to understand these cost estimating models as best suitable for Pagosa Springs. The parameter estimates themselves are not suitable for application to other communities, although the trends of higher density requiring fewer people per capita do hold.

This analysis should be used as a guideline for the Town of Pagosa Springs to consider the fact that context-sensitive higher density levels are not only beneficial from an economic, social equity, and environmental standpoint, but they also make financial sense. As portrayed, the Town stands to save an additional $89.80 million by building at dense levels already present in the Town; these levels of density are easily congruent with the character of the community. Continuing to build at low-density levels would yield heavy capital costs for major infrastructure items. These costs can be mitigated with a “smart growth” approach to new development.

Appendix A – Technical Output

Roads

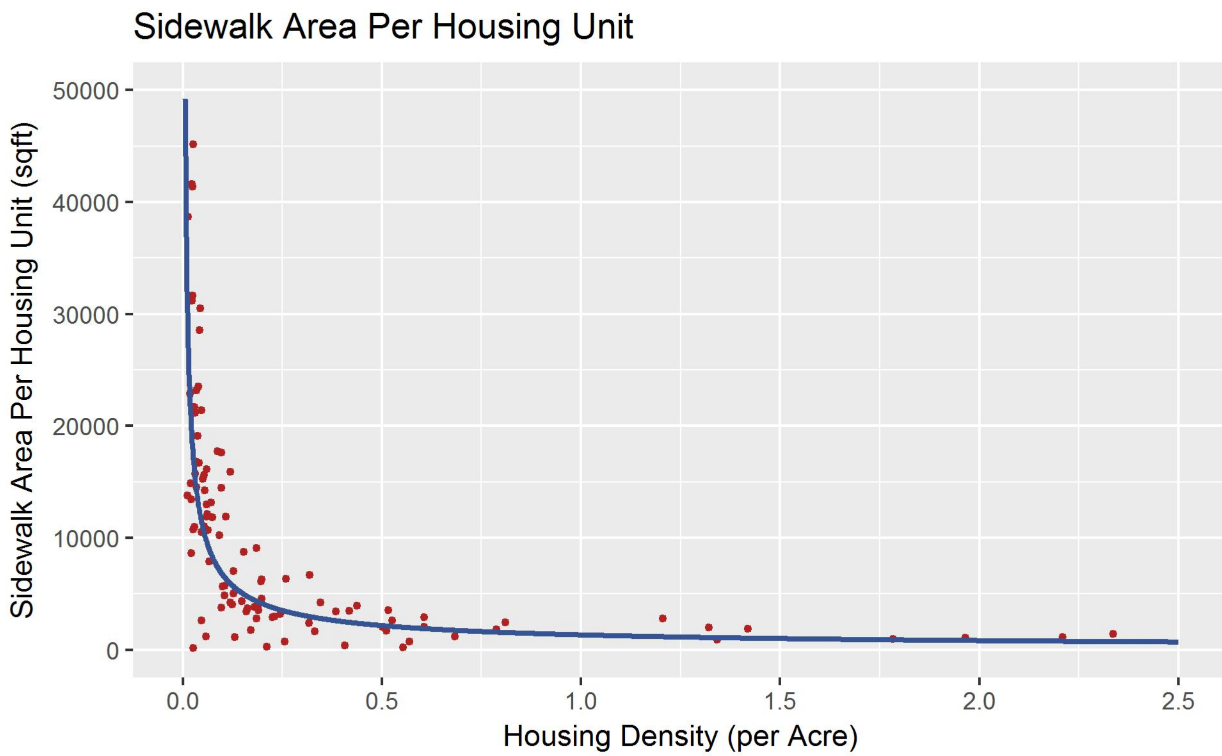


	Baseline	Alternative A	Alternative B
Unit Cost ($ / sq. ft.)	$30	$30	$30
Est. Road Area per Housing Unit (sq. ft.)	3,706	740	345
Est. Road Area Needed (sq. ft.)	2,224,726	444,286	207,066
Est. Cost of Road Needed ($)	66,741,782	13,328,568	6,211,986

Road Area Per Housing Unit by Housing Density

Dependent variable:	ln(Road_Per_HH)	
Mean:	11,650	
Standard Deviation:	20,390	
OLS:		
ln(Road_Per_HH)=7.194+ -0.694*ln(population per acre)		
log(PopDensity)		-0.694
Standard Deviation:		-0.033
	t = -20.838	
	p = 0.000***	
Constant		7.194
Standard Deviation		-0.075
	t = 95.580	
	p = 0.000***	
Observations		341
R^2		0.562
Adjusted R^2		0.56
Residual Std. Error	1.017 (df = 339)	
Sum Squared Residuals		
F Statistic	434.212*** (df = 1; 339)	
Akaike criterion		13.80
Log-likelihood		-488.76
Note:		*p**p***p<0.01

Sidewalks

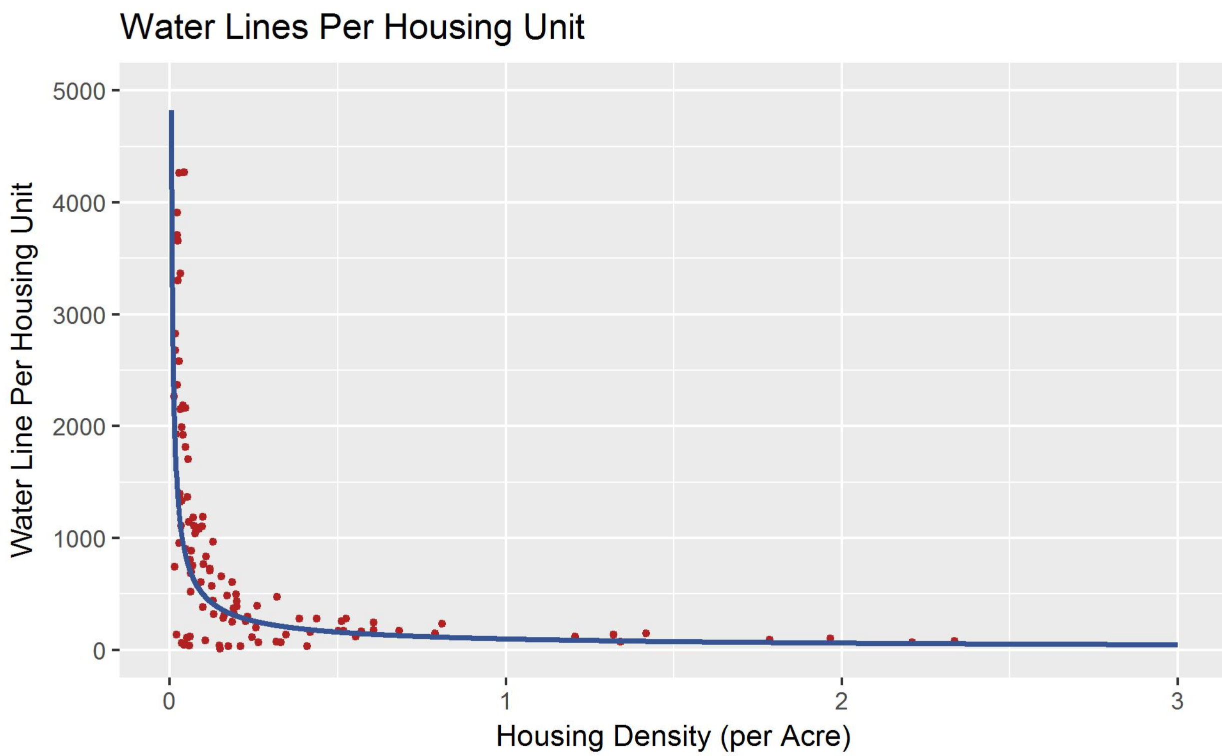


	Baseline	Alternative A	Alternative B
Unit Cost ($ / sq. ft.)	$4	$4	$4
Est. Sidewalk per Housing Unit (ft.)	1,483	296	138
Est. Sidewalk Needed (ft.)	890,149	177,766	82,851
Est. Cost of Sidewalk Needed (ft.)	3,560,597	711,064	331,402

Sidewalk Area Per Housing Unit by Housing Density

Dependent variable:	log(Sidewalk_Per_HH)	
Mean:	1,296	
Standard Deviation:	8,156	
OLS:		
=6.278+ -0.694*ln(population per acre)		
log(PopDensity)		-0.694
Standard Deviation:		-0.033
	t = -20.838	
	p = 0.000***	
Constant		6.278
Standard Deviation		-0.075
	t = 83.407	
	p = 0.000***	
Observations		341
R^2		0.562
Adjusted R^2		0.56
Residual Std. Error	1.017 (df = 339)	
Sum Squared Residuals		
F Statistic	434.211*** (df = 1; 339)	
Akaike criterion		13.80
Log-likelihood		-488.76
Note:		*p**p***p<0.01

Water Lines

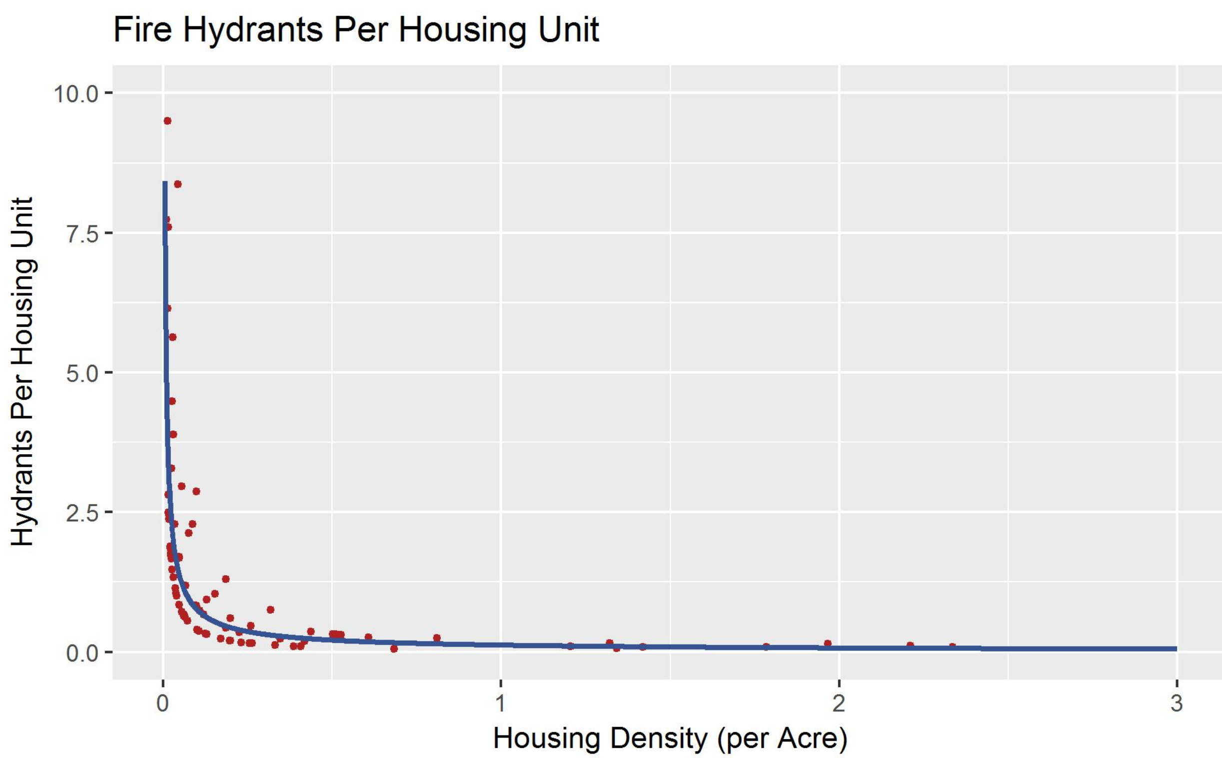


	Baseline	Alternative A	Alternative B
Unit Cost ($ / ft.)	$150	$150	$150
Est. Water Line per Housing Unit (ft.)	274.24	52.89	24.25
Est. Water Line Needed (ft.)	164,600	31,746	14,554
Est. Cost of Water Line ($)	24,690,023	4,761,961	2,183,065

Water Lines Per Housing Unit by Housing Density

Dependent variable:	log(Water_Line_Per_HH)	
Mean:	886.07	
Standard Deviation:	1,033.07	
OLS:		
=4.568+ -0.709*ln(population per acre)		
log(PopDensity)		-0.709
Standard Deviation:		-0.077
	t = -9.204	
	p = 0.000***	
Constant		4.568
Standard Deviation		-0.188
	t = 24.289	
	p = 0.000***	
Observations		107
R^2		0.447
Adjusted R^2		0.441
Residual Std. Error	1.011 (df = 105)	
Sum Squared Residuals		
F Statistic	84.711*** (df = 1; 105)	
Akaike criterion		4.36
Log-likelihood		-152.01
Note:		*p**p***p<0.01

Fire Hydrants



	Baseline	Alternative A	Alternative B
Unit Cost ($/each)	$10,000	$10,000	$10,000
Est. Fire Hydrants per Housing Unit	0.39	0.06	0.03
Est. Fire Hydrants Needed (each)	10,000	10,000	10,000
Est. Cost of Fire Hydrants Needed ($)	2,343,831	444,286	207,066

Fire hydrants Per Capita by Housing Density

Dependent variable:	log(hydrants_Per_HH)	
Mean:	1.44	
Standard Deviation:	1.98	
OLS:		
=-2.125+ -0.803*ln(population per acre)		
log(PopDensity)		-0.803
Standard Deviation:		-0.047
	t = -17.077	
	p = 0.000***	
Constant		-2.125
Standard Deviation		-0.121
	t = -17.626	
	p = 0.000***	
Observations		83
R^2		0.783
Adjusted R^2		0.780
Residual Std. Error	0.605 (df = 81)	
Sum Squared Residuals		
F Statistic	291.636*** (df = 1; 81)	
Akaike criterion		-81.34
Log-likelihood		-75.10
Note:		*p**p***p<0.01

[i] Colorado State Demography Office, 2016 Archuleta County Demographic and Economic Profile https://demography.dola.colorado.gov/community-profiles/

[ii] The GIS analysis was conducted using ESRI ArcGIS. For population density calculations, areas not within the Town's municipal borders were omitted. Population was divided into 25-acre cells from Census Block data using an aerial-weighted average calculation. Major water features were omitted from the aerial weight calculation.

[iii] Five percent operations and maintenance costs is consistent with engineering cost estimates in other communities that Smart Growth America has interviewed. It is also consistent with contingency allowances for capital cost estimation. This is in the range of assumptions commonly used in transportation cost estimating. See: http://www.samtrans.com/Assets/_Planning/BRT/Operating+and+Maintenance+Costs.pdf

[iv] Town of Pagosa Springs Proposed Budget, 2017.