How Big is Your Neighborhood?

Using the AHS and GIS to Determine the Extent of Your Community

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U.S. Census Bureau
June 13, 2013 (updated)
SEHSD Working Paper #FY2013-064

I am extremely grateful to Charles A. Bee, Aref N. Dajani, and Matthew B. Streeter of the U.S. Census Bureau and Michael K. Hollar and David A Vandenbroucke of the U.S. Department of Housing and Urban Development for their careful review of this report and their thoughtful feedback. Since I did not make all of the changes suggested by them, the reader should assume that any errors in this report reflect fixes that I neglected to make despite their recommendations.

Abstract

In this report, I use data from the 2009 American Housing Survey in conjunction with various GIS maps and tools to determine that the distance from the typical American's house to the edge of his community is between 520 and 1060 meters. This derived community extent is roughly equal to the radius of one or two median-sized census block groups. Not surprisingly, condo communities and communities with 50 or more housing units per building are smaller than communities of typical, detached single family homes. I also find a regional variation in community size: communities in the Midwest are larger than those in the South.

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Introduction

In a brief review of the academic literature on neighborhoods, one researcher notes that the term has not been well-defined (Taylor, 2012). He reports that researchers have been trying to build consensus around a definition of *neighborhood* or *community* for more than a century, yet these terms remain "some of the most notoriously slippery social science concepts." Part of the difficulty in settling on a suitable description could be that the physical size or extent of these areas also is not settled.

For example, Immergluck and Smith use census tracts to represent Chicago neighborhoods and find that 100 additional subprime loans over five years correspond to eight more foreclosures in the following year (Immergluck & Smith, 2005), and a one percentage point increase in the foreclosure rate increases violent crimes by 2.33 percent (Immergluck & Smith, 2006). These same researchers find that each foreclosure within an eighth of a mile[1] of a single-family home results in a 0.9% decline in property values, and that this spillover effect diminishes at a fourth of a mile (Immergluck & Smith, 2006b). Similarly, a report on the negative effect of foreclosures on property values in Las Vegas accounts for neighborhood effects by referencing properties within one city block of the foreclosed property (Carroll, Clauretie, & Neill, 1997).

Other research uses New York City zip codes as neighborhood proxies and concludes that "properties in close proximity to foreclosures sell at a discount (Schuetz, Been, & Ellen, 2008)." Just as earlier research on the effect of foreclosure on neighboring property values in Arlington, Texas (Forgey, Rutherford, & VanBuskirk, 1994) used zip codes to control for

[1] An eighth of a mile (201 meters) is about the double the radius of a median-sized census block (see Table 6).

neighborhood characteristics. In many cases, the selection of a particular neighborhood proxy seems based more on data availability or the researcher's intuition than a systematic analysis. But this choice makes it difficult to compare research results. Conceptually, a neighborhood that is assumed to be as large as a zip code must be different from one that is viewed to be as small as a city block.

What is the appropriate size for a neighborhood, and which of the U.S. Census Bureau's tabulation areas is closest to this size? In this report, I use responses from the 2009 American Housing Survey (AHS) as well as geographic information system (GIS) maps[2] and tools to conclude that the distance from the typical American's house to the edge of his or her community is between 520 and 1060 meters. This distance is roughly equal to the radius of one or two median-sized census block groups. I also report on similarities and differences in this derived neighborhood extent among various socioeconomic and demographic groups.

In 2009, the AHS asked respondents *"[is a] Beach, Park or Shoreline [among] the features included in your community?"* (throughout this report, I will refer to this question as BEACH, which is also its variable name in the 2009 AHS, see footnote 7). This item is one of the series of survey questions that researchers and policy-makers can use to gauge the quality and condition of respondents' neighborhoods – the survey designers refer to this set of questions as the "neighborhood quality" section of the AHS.

[2] For this report, I used three separate GIS datasources to determine the distance to the nearest beach or shoreline: Streams and Waterbodies of the United States from the United States Geological Survey (USGS), U.S. and Canada Water Polygons from Environmental Systems Research Institute (ESRI®) Data & Maps: StreetMap™, and U.S. and Canada Lakes from ESRI. I altered the first two datasets to remove water features that do not create shores or beaches (e.g., ponds and swamps).

Though all of the questions in the neighborhood quality section use the word "community," the survey never explicitly defines the term for the Census Bureau Field Representative or the respondent. However, the introductory questions in this series are:

1. *Is your community surrounded by walls or fences preventing access by persons other than residents?*
2. *Does access to your community require a special entry system such as entry codes, key cards, or security guard approval?*

In this context, the survey clearly leads typical respondents to conclude that their "community" encompasses a collection of properties within close proximity of their home that is so confined that access to the entire area could be monitored and controlled. Such a territory is probably larger than the set of properties on all of the respondent's adjacent lots but obviously smaller than the whole town or city where the respondent lives. In other words, most respondents probably conclude that "community" in this context is synonymous with their "neighborhood" or "subdivision." I will use these terms interchangeably in this report. [3]

More importantly, AHS respondents must use their own judgment to gauge the physical extent of their community when answering the neighborhood quality questions. Before responding to BEACH, respondents must first answer for themselves, "how many feet or miles away from my home does my community extend?" By contrast, survey items in other sections of the 2009 AHS asked respondents to report on the presence or absence of a neighborhood amenity at a defined distance (e.g., *is [the] public elementary school [for this address] within **one mile** of here?*). In this report, I will exploit the fact that the AHS does not specify an exact distance in the neighborhood quality section to derive the measure that best encompasses the concept of neighborhood for the largest share of respondents.

[3] These introductory questions also make clear that the AHS is asking about the respondent's *residential* community, and not (for example) his or her religious or ethnic community.

The research in this report relies on three aspects of the AHS that are collectively unique to the survey:

1. A large, representative, national housing sample
2. Questions about a neighborhood characteristic that do not reference a specific distance[4]
3. The ability to use GIS to geolocate the respondent's housing unit and the neighborhood characteristic, and to measure the distance between them

To protect the anonymity of survey respondents, the third aspect is only available to researchers with internal, secure access to the U.S. Census Bureau's databases who have sworn to be careful stewards of any information that could be used to identify a particular respondent. The findings in this report are further strengthened by the hundreds of other AHS questions that analysts and policy-makers use to create cross-tabulations and the replicate weights that researchers use to compute confidence intervals. In short, the AHS provides unparalleled insights into this report's research question: *How big is your neighborhood?*

A Simple Method

Deriving an answer to the research question relies on these two basic assumptions:

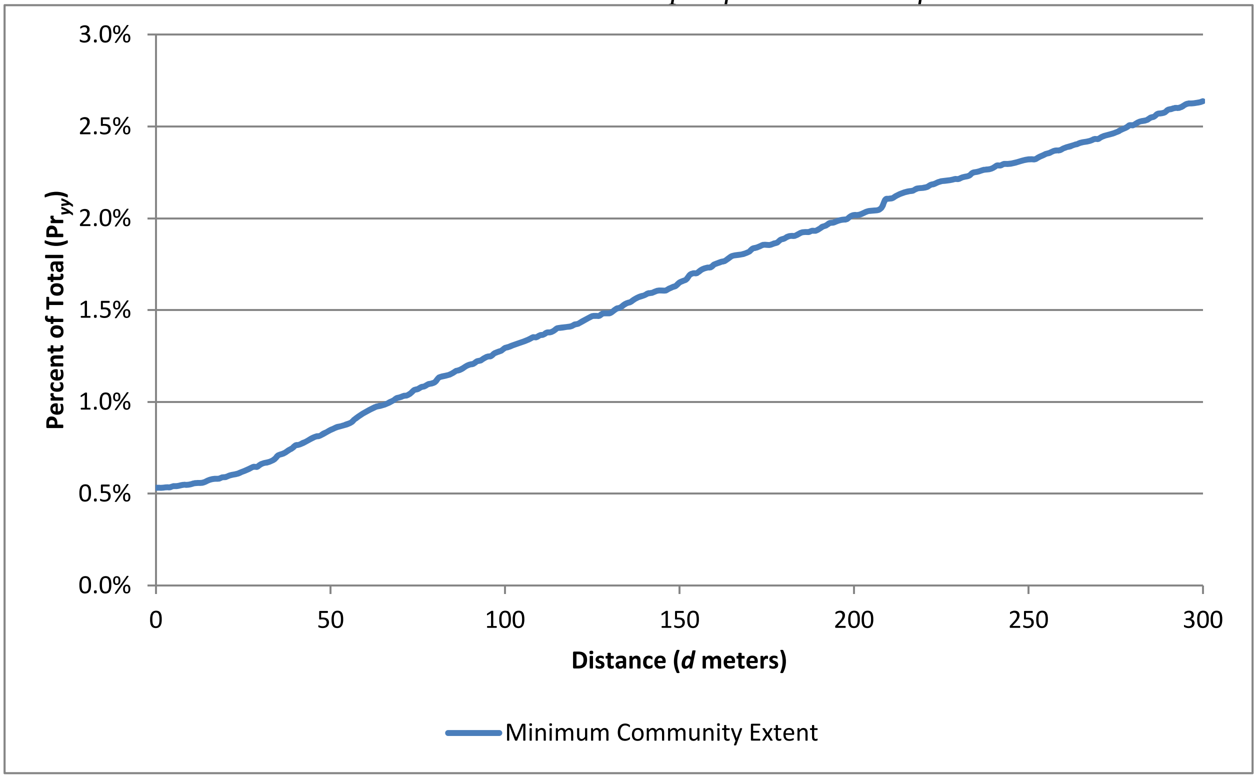
- ASSUMPTION 1: If a respondent reports that there is a prominent feature in his community, and I observe one of these features within a specified distance, then the minimum distance from his housing unit to the edge of his community is equal to or less than this specified distance. For example, if John Q. Public reports that there is a beach in his community, and GIS measures that there is a beach 200 meters away from his house, then the shortest distance from his residence to the edge of his community is 200 meters in the direction of the beach (but perhaps even shorter in a different direction).
- ASSUMPTION 2: If a respondent reports that there is *not* a prominent feature in her community, and I observe one of these features outside of a specified distance, then the maximum distance from her housing unit to the edge of her community is equal to or

[4]The neighborhood quality section of the 2009 AHS included multiple questions (see Appendix A for the complete listing) about the presence or absence of neighborhood amenities that could also be located on GIS maps (i.e., community centers, golf courses, trails, and day care centers). This report uses BEACH because the GIS maps of water bodies are most comprehensive and because this amenity is so prominent that respondents are unlikely to be in error when reporting on the presence or absence of this characteristic in their community.

> greater than this specified distance. For example, if Jane S. Doe reports that there is *not* a beach in her community, and GIS measures that there is beach 1000 meters away from her house, then the farthest distance from her residence to the edge of her community is 1000 meters in the direction of the beach (but perhaps even farther in a different direction).

As explained below, I can conclude from these two assumptions that the distance from respondents' residences to the edge of their communities is the distance that maximizes the overall agreement between the respondents' answers to BEACH and my GIS measurements. At any given distance, agreement occurs when a respondent reports that a feature is (is not) in his or her community and I use GIS to confirm that this feature is (is not) within that given distance. In this report, I will refer to the distance from the respondent's housing unit to the edge of his or her neighborhood as the *community extent*.

*Figure 1: Percent of Respondents Who Report that there is a Beach in Their Community **and** Who are Observed to be Within the Specified Distance of the Beach*



In Figure 1, we see the percent of respondents who report that a beach is in their community *and* who are observed to be within the specified distance of a beach. Specifically,

$$\Pr_{yy}(d) = \frac{R_{yy}(d)}{R_{total}}$$

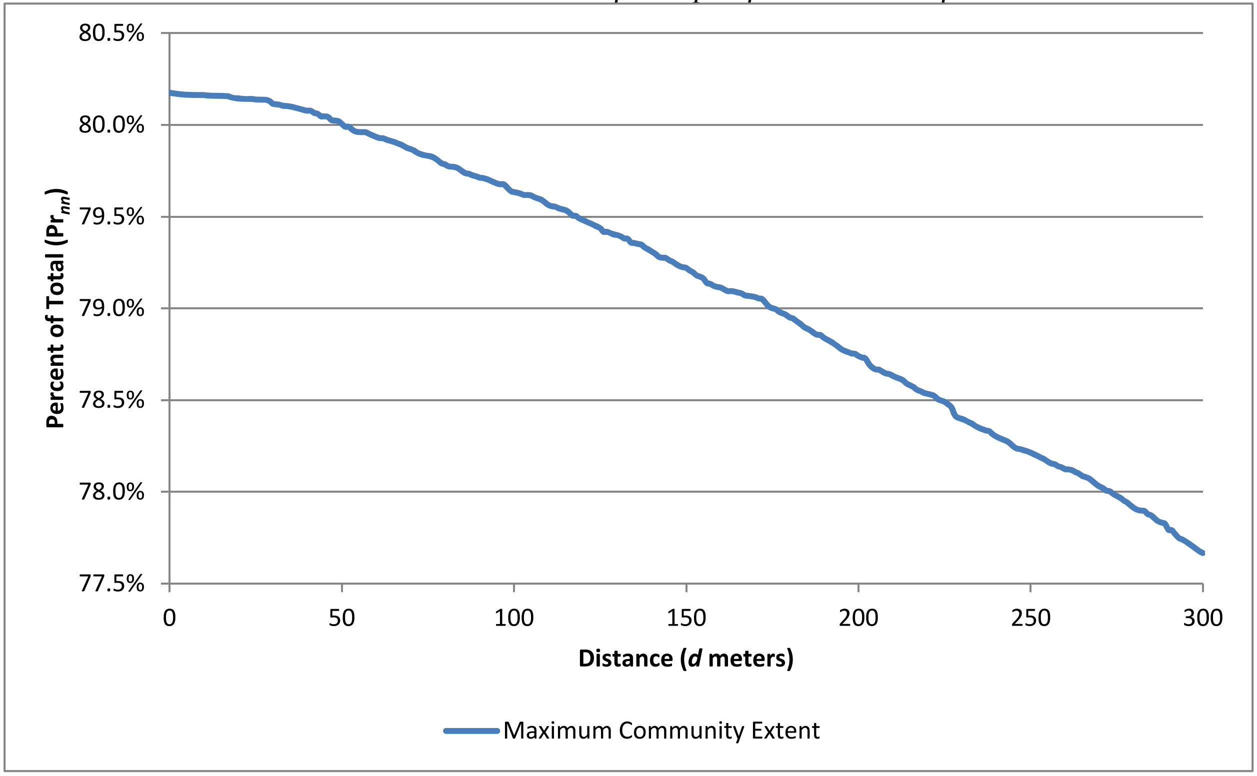
where R_{yy} is the number of respondents[5] who report that there is a beach in their community and who are observed to be within the specified distance, *d*, of the beach and R_{total} is the number of respondents who answered BEACH and whose residence could be pinpointed using GIS.

For example, it appears that 2% of AHS respondents report that a beach is in their community *and* are measured (using GIS) to be fewer than 200 meters away from a beach. By construction, the function illustrated in Figure 1 must be upward-sloping (or flat) – as distances increase, GIS

[5] Throughout this report, the "number of respondents" refers to the total weighted count of occupied housing units, not the unweighted count of interviewed cases (for the 2009 AHS, 1 case ≈ 2500 housing units).

will never find fewer respondents within the greater distance of the beach. At each distance in Figure 1, we can conclude from ASSUMPTION 1 that the corresponding percentage estimates the proportion of respondents for whom the minimum community extent is equal to or less than the specified distance.

Figure 2: Percent of Respondents Who Report that there is not a Beach in Their Community ***and*** *Who are Observed to be Outside of the Specified Distance of the Beach*



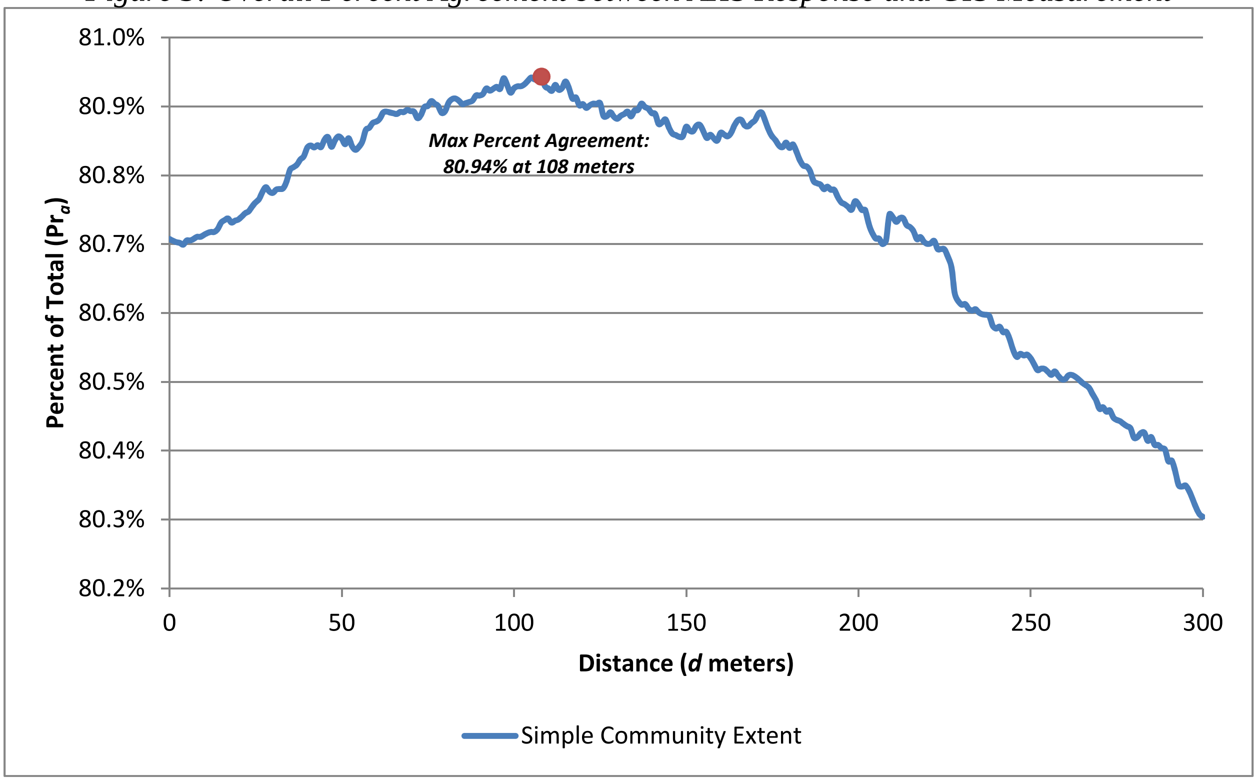
In Figure 2, we see the percent of respondents who report that a beach is *not* in their community *and* who are confirmed to be outside of the specified distance of a beach. In particular,

$$\mathrm{Pr}_{nn}(d) = \frac{R_{nn}(d)}{R_{total}}$$

where R_{nn} is the number of respondents who report that there is not a beach in their community and who are observed to be outside of the specified distance, d, of the beach.

For example, we see that 80% of AHS respondents report that a beach is *not* in their community and are measured (using GIS) to be more than 50 meters away from a beach. By construction, the function illustrated in Figure 2 must be downward-sloping (or flat) – as distances increase, GIS will never find more respondents outside of the greater distance of the beach. At each distance in Figure 2, we can conclude from ASSUMPTION 2 that the corresponding percentage estimates the proportion of respondents for whom the maximum community extent is equal to or greater than the specified distance.

Figure 3: Overall Percent Agreement between AHS Response and GIS Measurement



In Figure 3, we see the overall percent agreement between the respondents' answers and GIS measurements. For a given distance, the overall percent agreement, $\mathrm{Pr}_a(d)$, is the share of AHS respondents who gave a response to BEACH that I confirmed using GIS at the specified distance. Specifically,

$$\Pr_a(d) = \frac{R_{yy}(d) + R_{nn}(d)}{R_{total}}$$

It is clear from the above equation that the graph in Figure 3 is the vertical summation of the graphs in Figure 1 and Figure 2, and therefore represents a simple method for combining the implications of ASSUMPTION 1 and ASSUMPTION 2. At close distances, the graph of the function in Figure 3 seems to slope upward. This suggests that as we move away from the immediate vicinity of AHS households, the increase in respondents graphed in Figure 1 is larger (in absolute terms) than the decrease in respondents graphed in Figure 2. The opposite is true at the farthest distances where the apparently downward-sloping function indicates that at increasing distances, the increase in respondents graphed in Figure 1 is smaller (in absolute terms) than the decrease in respondents graphed in Figure 2.

The maximum percent agreement is 80.94% at a distance of 108 meters, and I have labeled this point in Figure 3. Movements away from the maximum distance will either sacrifice more respondents graphed in Figure 1 than we gain in Figure 2 (at decreasing distances) or *vice versa* (at increasing distances). Therefore, using this simple method in which I add together the findings illustrated in Figure 1 and Figure 2, we might conclude that the typical American's community extent is in the vicinity of 108 meters.

The Kappa Coefficient

Using a simple method, in the previous section I argued that the distance that maximizes the overall percent agreement marks a point that optimally combines the implications of ASSUMPTION 1 and ASSUMPTION 2. The main problem with this simple method is that the overall percent agreement gives too much weight to the respondent's graphed in Figure 2 – this explains why the function in Figure 3 starts decreasing (matching Figure 2) after only 108 meters. Since a large majority (80.5% , ±0.85%[6]) of AHS respondents report that they do *not* live near a beach, a one percent decrease in Figure 2's respondents will be much larger in absolute terms than a one percent increase in respondents graphed in Figure 1. In other words, changes in Figure 2 are more likely (compared to Figure 1) only because these respondents comprise a much larger share of the total population.

Cohen's kappa coefficient (or simply, the kappa coefficient) adjusts the overall percent agreement and compensates for this imbalance. The kappa coefficient calculates the level of agreement between a pair of Boolean responses or determinations while accounting for the level of agreement that would occur by chance (Cohen, 1960). This statistic is computed using the following formula:

$$\kappa(d) = \frac{\mathrm{Pr}_a(d) - \mathrm{Pr}_e(d)}{1 - \mathrm{Pr}_e(d)}$$

where $\mathrm{Pr}_a(d)$ is the observed percent agreement at distance, d,

$$\mathrm{Pr}_a(d) = \frac{R_{yy}(d) + R_{nn}(d)}{R_{total}}$$

[6] The ranges presented in this report represent the 95% confidence interval, unless otherwise stated. Following guidance from the American Housing Survey designers, I use replicate weights and Fay's Balanced Repeated Replication (BRR) method of variance estimation (U.S. Dept of Housing and Urban Development, 2012).

$\Pr_e(d)$ is the percent agreement that is expected to occur by random chance,

$$\Pr_e(d) = \left[\frac{R_{yy}(d) + R_{yn}(d)}{R_{total}} \times \frac{R_{yy}(d) + R_{ny}(d)}{R_{total}}\right] + \left[\frac{R_{nn}(d) + R_{yn}(d)}{R_{total}} \times \frac{R_{nn}(d) + R_{ny}(d)}{R_{total}}\right]$$

$R_{yy}(d)$ is the number of times that both determinations were positive,
$R_{yn}(d)$ is the number of times that the first determination was positive and the second determination was not positive,
$R_{ny}(d)$ is the number of times that the first determination was not positive and the second determination was positive,
$R_{nn}(d)$ is the number of times that both determinations were not positive,
and R_{total} is the total number determination pairs ($R_{total} = R_{yy} + R_{yn} + R_{ny} + R_{nn}$).

The kappa coefficient discounts one-sided situations in which both determinations are matched in the vast majority of cases – that is, situations in which both answers are almost always "Yes" or both are almost always "No". If the observed percent agreement Pr(a) is less than the expected percent agreement Pr(e), then kappa will be negative. In evaluating the level of agreement, Table 1 lists the conventional ranges for the kappa coefficient (Landis & Koch, 1977).

In Table 2, I calculate the kappa coefficient for AHS respondents who answered BEACH.[7] For the first example, I arbitrarily chose a community extent of 1000 meters. We see that 5.9 million households gave an affirmative answer to BEACH and are GIS-verified to be within 1000 meters of a beach. Similarly, 74.2 million households gave a negative response to BEACH and are GIS-confirmed to be more than 1000 meters away from a beach. However, 26.4 million households

Table 1: Kappa Coefficient Levels of Agreement Ranges

Poor	Less than 0
Slight	0.00 – 0.20
Fair	0.20 – 0.40
Moderate	0.40 – 0.60
Substantial	0.60 – 0.80
Almost Perfect	0.80 – 1.00

[7] I conclude from my research that most AHS respondents do not consider ordinary municipal, state or federal parks to qualify as a neighborhood feature that pertains to BEACH. Maximum kappa coefficients, when excluding various combinations of GIS maps of parks (i.e., including *only* beaches and shorelines), are always higher than maximum kappa coefficients including various combinations of park maps. Therefore, the research in the report uses only GIS maps of beaches and shorelines (not parks) when measuring the distance from the respondent to the nearest beach, park or shoreline.

gave a response to BEACH that was contradicted by GIS measurements at 1000 meters. At this distance, I calculate the observed percent agreement, Pr(*a*), to be 75.2% (±0.78%) and the kappa coefficient to be 0.1606 (±0.0161). According to Table 1, the level of agreement between the GIS measurement and the AHS response for this range of distances is "slight."

In Table 3 and Table 4, I repeat the calculations from Table 2 for 500 meters and 750 meters, respectively. Of these three distances (500m, 750m, 1000m), the overall percent agreement (79.2%, ±0.8%) is highest at 500 meters where we also find the largest proportion of respondents (75.5%) who answered "No" to BEACH and whose response at this distance is verified by GIS.[8] However, we see that the point estimate for the kappa coefficient (0.1666) is highest at 750 meters – the highest kappa coefficient and the highest percent agreement are not at the same distance. Comparing Table 3 and Table 4, we see that the higher kappa coefficient results from trading three reported percentage points in the predominant No/No response combination for just one more reported percentage point in the less likely Yes/Yes response combination. Hence, these examples show how the kappa coefficient discounts one-sided situations where one combination of AHS responses and GIS measurements overwhelmingly match.

[8] By construction, the percent of responses in the No/No combination will always be highest at the closest distances (i.e., Figure 2) and the proportion of responses in the Yes/Yes combination will always be highest at farthest distances (i.e., Figure 1).

*Table 2: AHS/GIS cross tabulation of BEACH at **1000m***				
		AHS Response		
		Yes	No	Total
GIS Measurement	Yes	5,940,558 5.6% (R_{yy})	11,562,050 10.8% (R_{yn})	17,502,608 16.4%
	No	14,849,758 13.9% (R_{ny})	74,212,141 69.6% (R_{nn})	89,061,899 83.6%
	Total	20,790,316 19.5%	85,774,191 80.5%	106,564,507 100.0% (R_{total})
Pr(*a*)		75.2% (±0.8%)		
Kappa coefficient		0.1606 (±0.0161)		

*Table 3: AHS/GIS cross tabulation of BEACH at **500m***				
		AHS Response		
		Yes	No	Total
GIS Measurement	Yes	3,913,686 3.7% (R_{yy})	5,340,813 5.0% (R_{yn})	9,254,499 8.7%
	No	16,876,630 15.8% (R_{ny})	80,433,378 75.5% (R_{nn})	97,310,008 91.3%
	Total	20,790,316 19.5%	85,774,191 80.5%	106,564,507 100.0% (R_{total})
Pr(*a*)		79.2% (±0.8%)		
Kappa coefficient		0.1595 (±0.0161)		

*Table 4: AHS/GIS cross tabulation of BEACH at **750m***				
		AHS Response		
		Yes	No	Total
GIS Measurement	Yes	5,056,267 4.7% (R_{yy})	8,463,838 7.9% (R_{yn})	13,520,105 12.7%
	No	15,734,049 14.8% (R_{ny})	77,310,352 72.5% (R_{nn})	93,044,401 87.3%
	Total	20,790,316 19.5%	85,774,190 80.5%	106,564,506 100.0% (R_{total})
Pr(*a*)		77.3% (±0.7%)		
Kappa coefficient		0.1666 (±0.0158)		

*Table 5: AHS/GIS cross tabulation of BEACH at **790m***				
		AHS Response		
		Yes	No	Total
GIS Measurement	Yes	5,240,055 4.9% (R_{yy})	8,971,931 8.4% (R_{yn})	14,211,986 13.3%
	No	15,550,261 14.6% (R_{ny})	76,802,260 72.1% (R_{nn})	92,352,521 86.7%
	Total	20,790,316 19.5%	85,774,191 80.5%	106,564,507 100.0% (R_{total})
Pr(*a*)		77.0% (±0.7%)		
Kappa coefficient		0.1675 (±0.0158)		

The Maximum Kappa Coefficient and the Derived Community Extent

Table 5 shows the housing unit estimates and the kappa coefficient at 790 meters, and in Figure 4 we see that the kappa coefficient for all AHS respondents is maximized near this distance. The kappa coefficient at 790 meters, 0.1675, is the largest value resulting from an algorithm that I developed to recursively search the range of all possible distances at 10-meter intervals for the maximum kappa coefficient.[9] This algorithm executed these following steps:

Step 1: Identify the respondents who are at the minimum and maximum distances from a beach or shoreline – this is the range. For all AHS respondents, the range of distances from their residence to the nearest beach or shoreline is 0 meters to over 80,000 meters (about 50 miles).

Step 2: Evenly divide the range into 200 segments and calculate the kappa coefficient at each of these distances (rounded to the nearest multiple of 10).

Step 3: Of these 200 distances, identify the maximum kappa coefficient and calculate the distances (rounded to the nearest multiple of 10) that are 25 segments (12.5% of the range) fewer than and 25 segments greater than this kappa-maximizing distance – this is the new range.

Step 4: If the new range is greater than 200 meters, repeat Step 2 and Step 3.

Step 5: If the new range is 200 meters or less, calculate the kappa coefficient at each distance (rounded to the nearest multiple of 10).

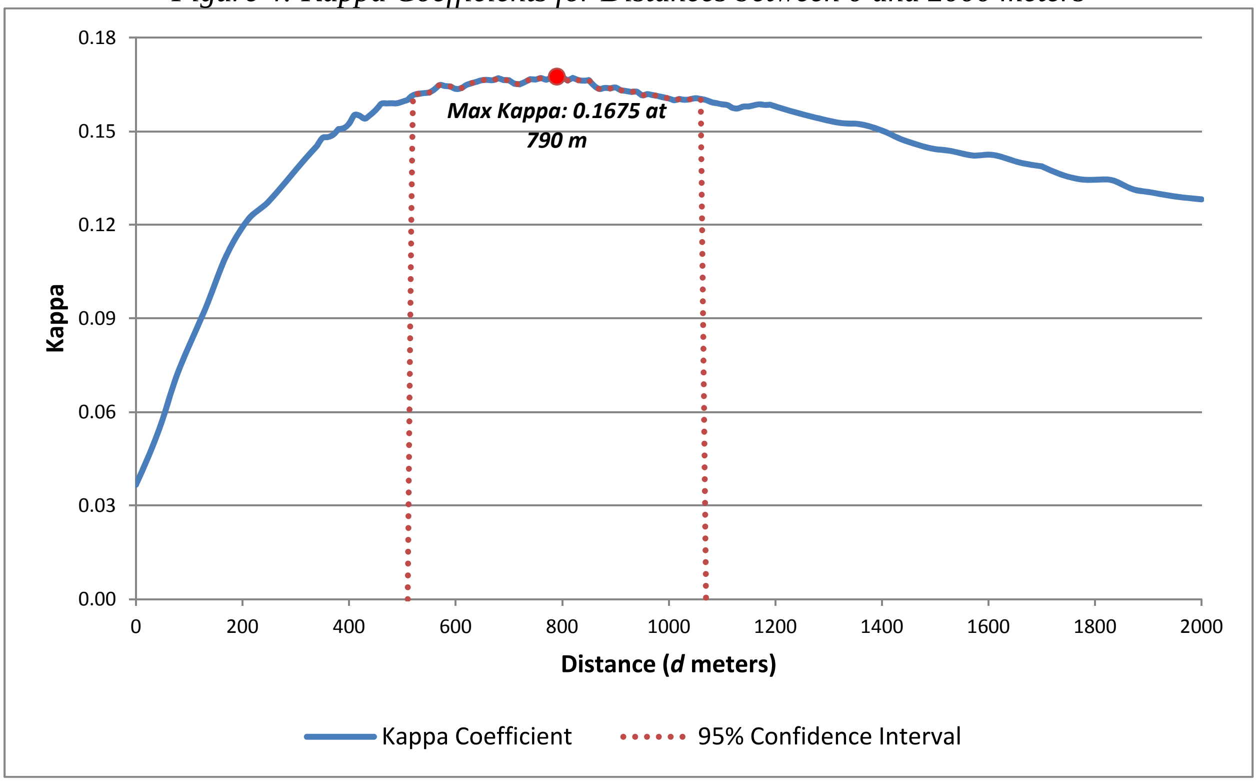
Step 6: Identify the distance with the maximum kappa coefficient within the new range, this is the maximum kappa and maximizing distance reported in this research.

In this report, I will refer to the distance that maximizes kappa as the *derived community extent*. This search function is effective because the graph of the kappa coefficient with respect to distance generally increases, reaches a peak, and then generally decreases. However, the function is not strictly concave; a local maximum is usually not the global maximum, and the

[9] Due to limited computer processing resources, the recursive search function only calculated and compared kappas at distances that were multiples of ten. I also round standard errors and confidence intervals for these maximizing distances to the nearest multiple of ten.

search function can differentiate between the two. This pattern is evident in Figure 4, where we also see that the graph of kappa coefficients is flat near the maximum point. Table 8 confirms that the 95% confidence interval for this derived community extent is 520 meters to 1060 meters. For context, I note that if a neighborhood extends 520 m –1060 m in all directions from the respondent's home, then his or her community is a circle that encompasses 0.85–3.53 km^2 (210–872 acres) in total area.

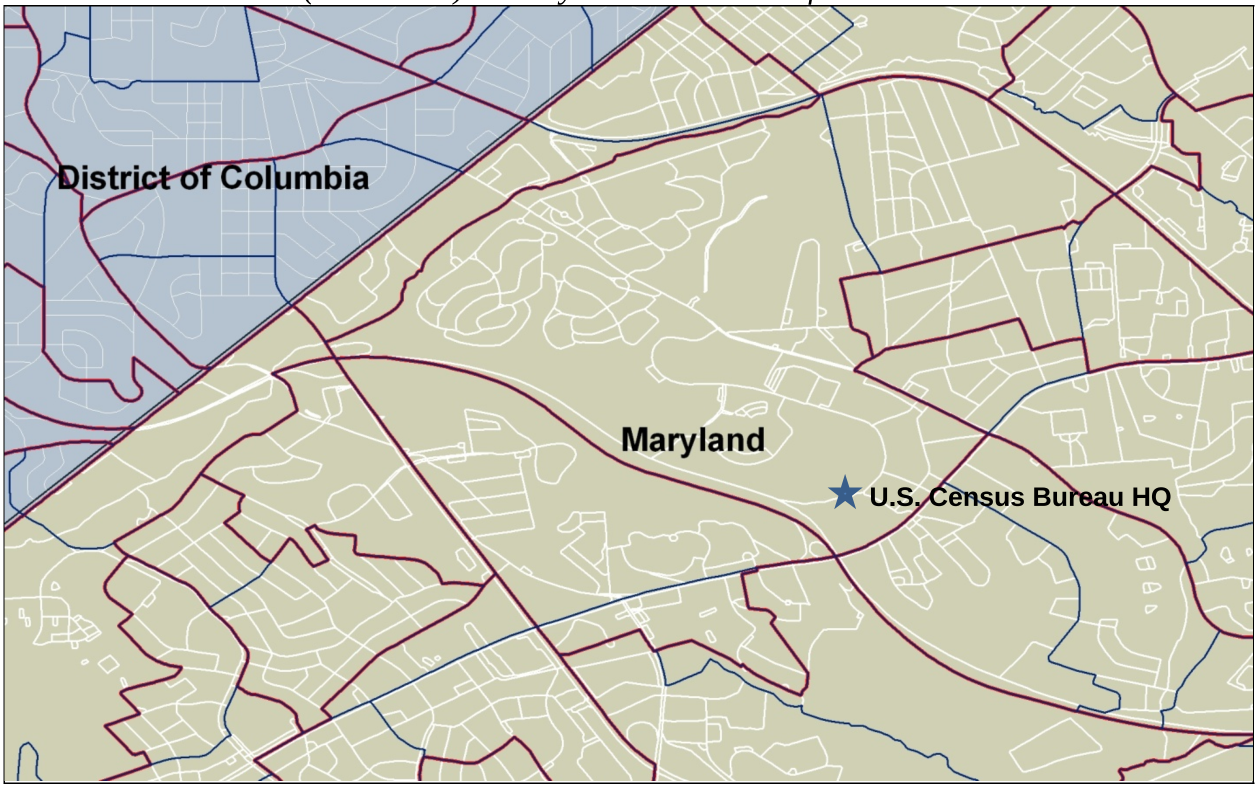
Figure 4: Kappa Coefficients for Distances between 0 and 2000 meters



In Table 6, I derive the average extent of the smallest tabulation areas produced by the U.S. Census Bureau: zip code tabulation areas (ZCTAs), census tracts, census block groups, and census blocks. Each mean derivation starts by dividing the total area of the United States (i.e., the total area of 50 states plus the District of Columbia) by the number of tabulation areas that the Census Bureau defines within the area. Next, I derive the average radius or extent of each tabulation area under various assumptions. For example, if we assume that ZCTAs are best represented by circles, then the mean radius of the ZCTA is 8,559 meters. Under this assumption, the mean ZCTA radius is 8 to 16 times longer than the derived community extent.

Table 6 also includes derivations for the median extents of the U.S. Census Bureau's smallest tabulation areas under the same assumptions. All of the tabulation areas include regions that encompass extremely large areas in the least populated parts of the United States – for example, each of the five largest census blocks (all in Alaska) is larger than Connecticut (which contains 67,578 census blocks). These massive areas skew the mean calculation and make the median a better measure of central tendency. Table 6 shows that if the median zip code were a circle, then its radius would be 5,533 meters, which is 5 to 11 times longer than the derived community extent. This implies that researchers who use zip codes to account for neighborhood effects are overestimating the range of these reactions.

Figure 5: Census Blocks (white outline), Census Block Groups (blue outline), and Census Tracts (red outline) in Maryland the District of Columbia

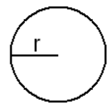
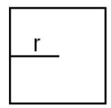
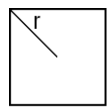
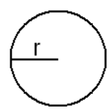
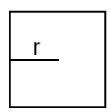
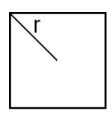


Source: TIGER/Line Shapefiles, 2012, U.S. Census Bureau, Geography Division

However, it is not realistic to assume that circles are the best representation of the smallest tabulation areas. Census blocks are generally bounded by streets or roads, which means that their edges are usually more straight than rounded. Since all of the larger tabulation areas are comprised of census blocks, their edges are also frequently straight. Figure 5, which is a map of a portion of Southeast Washington, DC and Prince George's County, MD, illustrates typical census tabulation areas. On this map, I outline census blocks in white, census block groups in blue, and census tracts in red.

In Table 6, I also calculate the shortest and longest extents of a median-sized tabulation area assuming that it is a square. For census blocks, the shortest extent (from the center of the square to the midpoint of any edge) under this assumption is 84 meters and the longest extent (from the center of the square to any corner) is 119 meters. Compared to the derived community extent (between 520 meters and 1060 meters), this implies that researchers who use census blocks to control for neighborhood effects are underestimating the range of these responses. Relative to the U.S. Census Bureau's tabulation areas, the best approximation of the derived community extent is between one and two median-sized census block groups. Since the median census block group contains 532 housing units, this further implies that the typical American community includes 500–1000 homes.

Table 6: Average Areas and Derived Extents of U.S. Census Bureau Tabulation Areas

	[redacted]	Figure	Equation	Zip Code Tab Area (ZCTA)	Census Tracts	Block Groups	Census Blocks
	Count			32,990	73,057	217,740	11,078,297
Mean	Area (square meters)[†]			230,135,677	134,600,885	45,161,830	887,640
Mean	Housing units[‡]			3,991	1,803	605	12
Mean	Derived radius (meters)		$r = \sqrt{\frac{Area}{\pi}}$	8,559	6,546	3,791	532
Mean	Derived extent (meters) if the area is a square, and the length extends to the *nearest* point on the square		$r = \sqrt{\frac{Area}{4}}$	7,585	5,801	3,360	471
Mean	Derived extent (meters) if the area is a square, and the length extends to the *farthest* point on the square		$r = \sqrt{\frac{Area}{2}}$	10,727	8,204	4,752	666
Median	Area (square meters)			96,160,479	5,206,992	1,377,784	28,373
Median	Housing units			N/A	1,706	532	2
Median	Derived radius (meters)		$r = \sqrt{\frac{Area}{\pi}}$	5,533	1,287	662	95
Median	Derived extent (meters) if the area is a square, and the length extends to the *nearest* point on the square		$r = \sqrt{\frac{Area}{4}}$	4,903	1,141	587	84
Median	Derived extent (meters) if the area is a square, and the length extends to the *farthest* point on the square		$r = \sqrt{\frac{Area}{2}}$	6,934	1,614	830	119

[†] The total area of the 50 U.S. States (plus Washington, DC) is 9,833,537 km^2. ZCTAs do not cover all areas of the United States; the total area of ZCTAs is 7,592,176 km^2.
[‡] The 2010 U.S. Census Bureau count of housing units in the 50 U.S. States (plus Washington, DC) is 131,704,730.
Source: See Appendix B

Maximum Kappa Coefficients and Derived Community Extents for Various Demographic and Socioeconomic Groups

Table 8 presents the derived community extents and maximum kappa coefficients for various demographic and socioeconomic groups. Using replicate weights (see footnote 6), I construct 95% confidence intervals around these estimates, and I have included these ranges in Table 8 as well. As explained in the previous section, the kappa coefficient for AHS respondents in all occupied housing units is maximized at a distance of 790 meters from the respondent's home. However, if the AHS sample were repeatedly drawn, this derived community extent would range between 520 meters and 1060 meters 95% of the time. This finding is consistent with other research that shows the spillover effect of foreclosures on neighboring property values in Chicago is not statistically significant beyond 900 meters (Lin, Rosenblatt, & Yao, 2009). The maximum kappa coefficient is 0.1675 (± 0.0158), and the range for these maximum kappa values indicates that there is a slight level of agreement between GIS measurements and AHS respondents regarding the presence or absence of beaches within the derived community extent.

Other noteworthy findings from Table 8 include:

- The derived community extent is smaller for renters than for owners, but this difference is not statistically significant. The maximum kappa coefficient for owners is higher than renters, and this difference is statistically significant at the 90% confidence level.

- The derived community extent is not statistically different across different racial groups. The maximum kappa coefficient is higher for White (alone) householders than for householders who are African-American (alone), Asian (alone), and Hispanic or Latino (any race), and there is evidence for this difference at the 95% confidence level.

- Respondents in buildings with 50 or more units in the structure live in smaller communities than those in ordinary single-family homes, and this difference is statistically significant at the 90% level. The difference in the kappa coefficient between any pair of structure types is not statistically significant.

- The derived community extent for residents in condominiums is small in comparison to the population in all occupied units. The point estimate for the maximum kappa coefficient for residents of these condo communities is higher than the point estimates for all other demographic and socioeconomic indicators analyzed in this report, and the difference is usually statistically significant. For context, Table 7 includes the weighted housing unit counts that contribute to this relatively high kappa calculation.

- Residents in older homes tend to live in larger communities. The Pearson correlation coefficient between the midpoints of the age ranges of homes and the point estimates of the derived community extents in Table 8 is 0.5465, *p*-value=0.0432. However none of the differences between any pair of age ranges is statistically significant.

- The differences in the derived community extent among residents who live inside central cities, within suburbs, and outside metro areas are not statistically significant. However, there is less agreement about the presence or absence of beaches in central cities than outside of MSAs based on the maximum kappa coefficient.

- Communities in the Midwest are larger than Southern communities and this difference is evident at the 95% confidence level. Agreement on the presence or absence of beaches within the derived community extent is higher in the South than in every other region of the country, and this difference is also statistically significant at the 95% level.

- There is no statistically significant difference in the derived community extent or maximum kappa values among respondents who live in places with various populations.

Table 7: AHS/GIS cross tabulation of BEACH for ***condo residents*** *at* ***410m***

		AHS Response		
		Yes	No	Total
GIS Measurement	Yes	384,460 6.2% (R_{yy})	373,155 6.0% (R_{yn})	757,615 12.2%
	No	721,294 11.6% (R_{ny})	4,733,251 76.2% (R_{nn})	5,454,545 87.8%
	Total	1,105,754 17.8%	5,106,406 82.2%	6,212,160 100.0% (R_{total})
Pr(*a*)			82.4% (±1.6%)	
Kappa coefficient			0.3132 (±0.0499)	

Table 8: Maximum Kappa Coefficient and the Derived Community Extent for Various Characteristics[10]

Characteristic	Derived Community Extent (m) Point Est.	Std. Error	Lower Bound	Upper Bound	Maximum Kappa Coefficient Point Est.	Std. Error	Lower Bound	Upper Bound
All occupied units	790	140	520	1060	0.1675	0.0080	0.1518	0.1833
Tenure								
Owner occupied	820	140	540	1100	0.1822	0.0107	0.1613	0.2032
Renter occupied	760	130	510	1010	0.1441	0.0105	0.1235	0.1646
Race and Hispanic Origin								
White alone	680	140	410	950	0.1802	0.0094	0.1619	0.1986
Non-Hispanic	680	130	430	930	0.1890	0.0102	0.1689	0.2091
Hispanic	1410	860	-280	3100	0.1216	0.0181	0.0861	0.1570
Black alone	960	240	480	1440	0.0937	0.0167	0.0609	0.1264
Non-Hispanic	960	330	310	1610	0.0871	0.0167	0.0544	0.1197
Hispanic	520	430	-320	1360	0.2802	0.1101	0.0645	0.4960
American Indian or Alaska Native alone	750	410	-60	1560	0.1569	0.0837	-0.0071	0.3210
Asian alone	360	650	-910	1630	0.0765	0.0288	0.0200	0.1330
Pacific Islander alone†	3290	4470	-5470	12050	0.1495	0.1571	-0.1584	0.4573
Two or more races	1410	890	-330	3150	0.2472	0.0568	0.1359	0.3585
Hispanic or Latino (any race)‡	1340	1040	-710	3390	0.1187	0.0184	0.0825	0.1548
Units in Structure								
1, detached	820	60	700	940	0.1718	0.0107	0.1508	0.1928
1, attached	800	240	330	1270	0.1310	0.0264	0.0794	0.1827
2 to 4	460	640	-800	1720	0.1502	0.0196	0.1118	0.1886
5 to 9	740	210	330	1150	0.1376	0.0311	0.0767	0.1985
10 to 19	750	170	420	1080	0.2006	0.0293	0.1433	0.2580
20 to 49	880	370	160	1600	0.1594	0.0312	0.0983	0.2205
50 or more	430	160	110	750	0.2224	0.0282	0.1671	0.2776
Manufactured/mobile home or trailer	420	310	-190	1030	0.2974	0.0638	0.1724	0.4225
Cooperatives and Condominiums								
Cooperatives	240	630	-990	1470	0.2472	0.0748	0.1006	0.3939
Condominiums	410	120	170	650	0.3132	0.0254	0.2635	0.3630
Year Structure Built								
2005 to 2009	550	1120	-1640	2740	0.1609	0.0437	0.0753	0.2465
2000 to 2004	590	80	440	740	0.1916	0.0297	0.1333	0.2498
1995 to 1999	760	480	-190	1710	0.1831	0.0285	0.1272	0.2390
1990 to 1994	850	110	640	1060	0.2746	0.0393	0.1976	0.3515
1985 to 1989	780	300	190	1370	0.2246	0.0252	0.1753	0.2740
1980 to 1984	700	220	260	1140	0.2066	0.0287	0.1502	0.2629

[10] The characteristics and categories in Table 8 match the definitions and selection criteria used in Table 2-1, Introductory Characteristics—Occupied Units of *American Housing Survey for the United States: 2009, Current Housing Reports* (March 2011).

Table 8: Maximum Kappa Coefficient and the Derived Community Extent for Various Characteristics[10]

Characteristic	Derived Community Extent (m) Point Est.	Std. Error	Lower Bound	Upper Bound	Maximum Kappa Coefficient Point Est.	Std. Error	Lower Bound	Upper Bound
1975 to 1979	550	190	180	920	0.1705	0.0228	0.1258	0.2152
1970 to 1974	780	220	360	1200	0.2124	0.0223	0.1688	0.2561
1960 to 1969	1180	710	-220	2580	0.1491	0.0170	0.1158	0.1824
1950 to 1959	850	640	-390	2090	0.1307	0.0176	0.0962	0.1651
1940 to 1949	1070	280	510	1630	0.1432	0.0235	0.0971	0.1893
1930 to 1939	710	150	410	1010	0.1418	0.0266	0.0896	0.1940
1920 to 1929	1430	1100	-720	3580	0.1030	0.0259	0.0522	0.1538
1919 or earlier	770	280	210	1330	0.1604	0.0225	0.1163	0.2044
Metropolitan/Nonmetropolitan Areas								
Inside metropolitan statistical areas	800	110	580	1020	0.1557	0.0075	0.1410	0.1704
In central cities	790	180	430	1150	0.1276	0.0108	0.1064	0.1488
Suburbs	640	220	200	1080	0.1725	0.0100	0.1528	0.1922
Outside metropolitan statistical areas	750	210	330	1170	0.2221	0.0300	0.1634	0.2808
Regions								
Northeast	680	190	300	1060	0.1501	0.0136	0.1235	0.1767
Midwest	1350	300	750	1950	0.1488	0.0180	0.1136	0.1840
South	500	80	340	660	0.2312	0.0194	0.1931	0.2692
West	790	90	610	970	0.1427	0.0225	0.0986	0.1868
Place Size								
Fewer than 2,500 persons	860	330	220	1500	0.1888	0.0392	0.1120	0.2656
2,500 to 9,999 persons	840	180	480	1200	0.1514	0.0205	0.1112	0.1917
10,000 to 19,999 persons	1400	950	-450	3250	0.1031	0.0231	0.0578	0.1483
20,000 to 49,999 persons	680	200	280	1080	0.1225	0.0164	0.0903	0.1547
50,000 to 99,999 persons	740	330	100	1380	0.1264	0.0190	0.0892	0.1635
100,000 to 249,999 persons	790	310	190	1390	0.1695	0.0251	0.1202	0.2188
250,000 to 499,999 persons	500	400	-290	1290	0.0604	0.0214	0.0185	0.1023
500,000 to 999,999 persons	1190	20	1160	1220	0.1669	0.0328	0.1026	0.2311
1,000,000 persons or more	430	1080	-1690	2550	0.1043	0.0185	0.0681	0.1405

† Native Hawaiian and Other Pacific Islander.

‡ Because Hispanics may be any race, data can overlap slightly with other groups. Most Hispanics report themselves as White, but some report themselves as Black or in other categories.

An Alternative Method for Deriving Neighborhood Size

In previous sections of this report, I derived the community extent by comparing the incidence of AHS respondents who report that a beach or shoreline is in their neighborhood with the GIS-measured distance to the nearest body of water. I defined this derived community extent as the distance at which the level of agreement (measured by the kappa coefficient) between the AHS response and the GIS measurement is maximized. However, this distance is difficult to interpret. For example, it is convenient to assume that the derived community extent is the same distance in every direction from the respondent, but this implies that each neighborhood is circle with its center at the respondent's home. Alternatively, for the sake of analytical ease, we might imagine that each neighborhood is a square and the derived community extent measures the distance to the nearest or farthest points of the square, but this assumption also fails to capture the unlimited variety of neighborhood shapes and sizes.

In reality, no community in America is a perfectly symmetric shape with a smooth boundary centered on an AHS respondent. Actual communities are usually simple polygons with borders formed by well-established, often-winding landmarks like highways, rivers and streams, political jurisdictions, etc. Not incidentally, the U.S. Census Bureau uses many of these same boundaries to help mark the edges of census blocks, block groups, tracts and ZCTAs.[11] This makes these tabulation areas ideal proxies for actual neighborhoods. In this section, I will derive an estimate of community size that takes advantage of the potential alignment between actual neighborhoods and tabulation areas.

[11] In the hierarchy of physical features that the U.S. Census Bureau uses to create the boundaries of census blocks, the highest priority shapes are (in order): water areas, named and unnamed roads, and political jurisdictions (U.S. Census Bureau, 1994).

Similar to the approach that I described in the previous sections (which I will refer to as *Method A*), I will compare the incidence of AHS respondents who report that a beach or shoreline is in their community with the GIS-determined presence or absence of a significant body of water within census tabulation areas. Then I will identify the tabulation areas (grouped by size) that maximize the level of agreement (measured by kappa) between the AHS response and the GIS observation. I will call this second approach *Method B.*[12]

As an example, see Figure 6, which is a map identifying census blocks (white outline), block groups (blue outline), and tracts (red outline) in Miami Beach, FL. For the sake of this example, I have pinpointed two hypothetical AHS respondents. Imagine that Respondent A answered "Yes" to BEACH. Since neither her census block nor block group border the ocean, these tabulation areas obviously cannot outline the area that she would say is in her community – I assume that these areas are too small. If her neighborhood is coextensive with a census tabulation area, then it must match either her census tract or ZCTA (none of Miami Beach's five zip codes is landlocked).

Figure 6: Census Blocks (white outline), Census Block Groups (blue outline), and Census Tracts (red outline) in Miami Beach, FL

Source: TIGER/Line Shapefiles, 2012, U.S. Census Bureau
Note: I chose the location of Respondent A and Respondent B for the purpose of this illustration. These locations may or may not pinpoint the addresses of actual AHS respondents.

[12] I acknowledge and thank .Charles A. Bee, my colleague at the U.S. Census Bureau, for proposing Method B.

Alternatively, consider Respondent B who answered "No" to BEACH. Since this respondent's block group, tract and ZCTA border the ocean, I conclude that these tabulation areas are too big to match this respondent's conception of his community. If a tabulation area happens to be coterminous with this respondent's community, then it must be his census block.[13] When creating tabulation areas, the U.S. Census Bureau respects many of the same natural and political boundaries that outline actual communities, which means that a tabulation area might share the same physical space as real neighborhoods and subdivisions. However, this will *only* be true for AHS survey respondents when their answer to BEACH agrees with the GIS-determined presence or absence of a body of water in the tabulation area. My objective in Method B is to identify the size of tabulation areas that maximizes the level of agreement between the AHS response and the GIS determination.

Table 9 details the results of this analysis, which proceeded along these steps.

Step 1: Locate every AHS respondent who answered BEACH within his or her census block, block group, tract and ZCTA, and create an expanded AHS sample that includes duplicate entries for each of these four tabulation areas.

Step 2: Sort this expanded sample by the size of the tabulation area, and divide this dataset into 120 classes having roughly the same weighted number of housing units (not the unweighted number of cases). For the sample of all occupied housing units, I find that the average area of the smallest class is approximately equal to the playing surface of an American football field, and the average area in the largest class is larger than the cities of Los Angeles and Chicago combined. The median-sized class is the same size as New York City's Central Park.

Not surprisingly, the smallest classes are entirely composed of census blocks, and the largest classes are dominated by ZCTAs. The derived radius in Table 9 is the distance from the center of the average area to its edge assuming that its shape is a circle: $derived\ radius = \sqrt{average\ area/\pi}$.

[13] Method B separately considers four tabulation areas (blocks, block groups, tracts and ZCTAs) as potential neighborhoods that align with the respondent's own community, therefore this analysis counts each interview as many as four times.

Step 3: Determine the AHS Response/GIS Determination combination of weighted household counts within each class. Notice the pattern of disagreement between the AHS Response and the GIS Determination in Table 9. Where there is disagreement in the smallest areas, it is overwhelmingly because the AHS respondent gave an affirmative answer to BEACH but GIS determined that the tabulation area does not contain a large body of water. Disagreement in the largest areas is primarily due to the AHS respondent giving a negative response to BEACH where GIS determined that there is a body of water within the tabulation area.

Step 4: Calculate the percent agreement and the kappa coefficient for each class and identify the maximum kappa coefficient. For the sample of all occupied housing units, the kappa coefficient is maximized in the 58th class. The average size for the 58th class is comparable in area to the primary airport in Baton Rouge, LA (BTR), Buffalo, NY (BUF) or Santa Barbara, CA (SBA). The derived radius for this class (987 meters) implies that these tabulation areas fit within the 95% confidence interval of the derived community extent that I calculated earlier in this report using Method A (between 520 and 1060 meters).

Table 9: Selected Statistics by Class Using Method B for All Occupied Housing Units

		Average Area	Derived		Block			AHS Response/GIS Determination				Percent	Kappa	Smooth
Class	Housing Units	(m^2)	Radius (m)	Blocks	Groups	Tracts	ZCTAs	Yes/Yes	No/Yes	Yes/No	No/No	Agree	Coeff.	Kappa
1	3,549,533	5,142	40	100%	0%	0%	0%	17,531	28,741	926,405	2,576,856	73.1%	0.0108	
2	3,552,921	8,884	53	100%	0%	0%	0%	11,407	15,341	837,083	2,689,089	76.0%	0.0116	
3	3,547,052	11,272	60	100%	0%	0%	0%	33,968	16,693	721,923	2,774,468	79.2%	0.0590	0.0252
4	3,554,486	13,436	65	100%	0%	0%	0%	21,007	21,252	841,768	2,670,459	75.7%	0.0243	0.0285
5	3,552,276	15,586	70	99%	1%	0%	0%	17,672	21,038	815,607	2,697,959	76.4%	0.0201	0.0304
6	3,551,547	17,589	75	98%	2%	0%	0%	15,950	11,616	718,263	2,805,718	79.4%	0.0273	0.0333
7	3,550,045	19,612	79	99%	1%	0%	0%	16,315	19,363	766,038	2,748,329	77.9%	0.0211	0.0345
8	3,553,198	21,544	83	98%	2%	0%	0%	41,929	14,723	731,182	2,765,364	79.0%	0.0735	0.0455
9	3,551,292	24,046	87	97%	3%	0%	0%	29,528	36,287	831,413	2,654,064	75.6%	0.0303	0.0435
10	3,551,485	27,157	93	98%	2%	0%	0%	37,560	14,082	659,439	2,840,404	81.0%	0.0753	0.0439
11	3,551,209	30,675	99	96%	4%	0%	0%	18,891	35,111	766,231	2,730,976	77.4%	0.0171	0.0307
12	3,550,409	34,775	105	95%	5%	0%	0%	18,599	31,324	689,407	2,811,079	79.7%	0.0234	0.0349
13	3,550,923	39,351	112	94%	6%	0%	0%	16,088	41,411	783,533	2,709,892	76.8%	0.0076	0.0366
14	3,550,922	44,748	119	93%	7%	0%	0%	30,454	33,622	644,825	2,842,020	80.9%	0.0511	0.0536
15	3,550,699	52,126	129	91%	9%	0%	0%	48,949	28,066	691,714	2,781,970	79.7%	0.0837	0.0791
16	3,552,516	61,140	140	89%	11%	0%	0%	59,117	62,104	588,006	2,843,289	81.7%	0.1023	0.0957
17	3,552,379	71,907	151	86%	12%	1%	0%	75,792	17,079	628,388	2,831,121	81.8%	0.1510	0.1146
18	3,551,247	85,378	165	85%	14%	1%	0%	52,883	62,181	584,993	2,851,190	81.8%	0.0905	0.1233
19	3,549,964	101,944	180	80%	18%	2%	0%	71,998	57,558	529,224	2,891,184	83.5%	0.1457	0.1308
20	3,552,434	121,817	197	73%	23%	4%	0%	77,653	45,872	666,561	2,762,349	79.9%	0.1269	0.1200
21	3,550,452	144,179	214	67%	24%	10%	0%	77,543	66,316	567,192	2,839,400	82.2%	0.1397	0.1210
22	3,553,450	166,163	230	53%	29%	18%	0%	67,841	76,925	643,539	2,765,145	79.7%	0.0974	0.1078
23	3,550,113	189,155	245	57%	29%	14%	0%	63,528	98,745	563,156	2,824,683	81.4%	0.0954	0.1127
24	3,551,664	217,505	263	53%	36%	10%	0%	60,019	82,909	647,486	2,761,250	79.4%	0.0795	0.1110
25	3,550,524	248,991	282	47%	44%	8%	0%	117,107	118,275	635,508	2,679,633	78.8%	0.1513	0.0998
26	3,552,455	281,947	300	47%	46%	8%	0%	90,338	127,464	549,571	2,785,082	80.9%	0.1312	0.0987
27	3,549,955	316,794	318	36%	54%	10%	0%	43,759	95,979	654,810	2,755,406	78.9%	0.0415	0.1117
28	3,553,038	349,773	334	39%	53%	9%	0%	73,295	99,854	659,947	2,719,941	78.6%	0.0900	0.0964
29	3,546,341	387,887	351	33%	55%	12%	0%	93,550	89,616	596,179	2,766,996	80.7%	0.1445	0.0920
30	3,556,304	430,156	370	35%	54%	11%	0%	70,813	133,104	627,222	2,725,165	78.6%	0.0749	0.1099
31	3,549,869	474,275	389	27%	61%	12%	0%	99,758	138,400	660,180	2,651,531	77.5%	0.1089	0.1101
32	3,552,438	518,186	406	28%	60%	11%	0%	129,595	191,990	623,341	2,607,512	77.0%	0.1310	0.1032
33	3,552,694	566,885	425	25%	60%	15%	0%	85,801	144,968	634,297	2,687,628	78.1%	0.0910	0.1061
34	3,551,071	616,740	443	24%	61%	14%	0%	86,335	129,423	596,068	2,739,245	79.6%	0.1101	0.1058
35	3,550,959	658,236	458	18%	65%	17%	0%	66,314	121,490	557,958	2,805,198	80.9%	0.0893	0.1172
36	3,551,307	705,964	474	23%	60%	16%	2%	106,511	183,441	611,045	2,650,310	77.6%	0.1077	0.1229
37	3,552,382	765,617	494	25%	60%	15%	0%	165,369	169,155	620,527	2,597,331	77.8%	0.1879	0.1177
38	3,549,990	827,769	513	22%	59%	18%	1%	118,613	220,636	564,617	2,646,125	77.9%	0.1196	0.1177
39	3,552,614	894,129	533	23%	54%	23%	1%	95,995	239,569	540,449	2,676,601	78.0%	0.0842	0.1177
40	3,551,623	965,993	555	22%	52%	25%	1%	106,703	242,612	573,207	2,629,101	77.0%	0.0890	0.1031
41	3,548,641	1,036,220	574	20%	52%	25%	2%	106,262	251,395	498,179	2,692,804	78.9%	0.1079	0.1150
42	3,553,031	1,116,167	596	18%	52%	29%	1%	120,296	256,503	531,943	2,644,289	77.8%	0.1148	0.1160
43	3,550,334	1,200,484	618	19%	49%	31%	1%	160,240	259,821	496,580	2,633,693	78.7%	0.1791	0.1128
44	3,552,157	1,279,055	638	14%	43%	43%	1%	78,997	184,194	520,645	2,768,321	80.2%	0.0893	0.1158
45	3,552,325	1,346,817	655	18%	45%	37%	1%	98,402	257,313	561,683	2,634,927	76.9%	0.0731	0.1118
46	3,551,123	1,437,011	676	16%	47%	35%	2%	140,243	317,102	503,020	2,590,759	76.9%	0.1228	0.1135
47	3,550,151	1,543,722	701	15%	40%	42%	3%	119,429	284,901	546,865	2,598,957	76.6%	0.0948	0.1103
48	3,552,934	1,655,841	726	18%	39%	41%	3%	193,835	354,638	456,246	2,548,216	77.2%	0.1874	0.1270
49	3,551,655	1,769,588	751	15%	42%	41%	2%	135,489	375,139	551,269	2,489,758	73.9%	0.0735	0.1101
50	3,551,252	1,892,028	776	14%	36%	45%	4%	163,310	283,308	532,765	2,571,870	77.0%	0.1566	0.1210
51	3,551,782	2,016,421	801	13%	36%	49%	2%	83,678	289,215	553,738	2,625,152	76.3%	0.0382	0.1074
52	3,550,971	2,158,234	829	15%	35%	47%	3%	197,042	389,242	514,983	2,449,704	74.5%	0.1495	0.1072
53	3,550,921	2,294,293	855	14%	36%	46%	4%	182,061	443,957	491,019	2,433,884	73.7%	0.1194	0.1017
54	3,550,634	2,444,877	882	13%	34%	50%	3%	136,112	364,328	570,258	2,479,936	73.7%	0.0725	0.1160
55	3,552,465	2,578,116	906	13%	26%	58%	3%	110,243	207,500	519,975	2,714,747	79.5%	0.1290	0.1053
56	3,549,962	2,691,009	926	12%	29%	55%	5%	162,622	401,394	508,137	2,477,809	74.4%	0.1097	0.1254
57	3,552,802	2,862,014	954	13%	30%	45%	11%	174,894	499,843	474,628	2,403,438	72.6%	0.0957	0.1339
58	3,551,623	3,063,461	987	11%	33%	53%	3%	259,892	448,828	425,184	2,417,718	75.4%	0.2199	0.1330
59	3,551,447	3,292,028	1,024	10%	32%	51%	7%	176,091	492,980	436,931	2,445,446	73.8%	0.1153	0.1207
60	3,550,938	3,527,420	1,060	12%	27%	54%	7%	214,756	507,186	492,713	2,336,283	71.8%	0.1242	0.1255
61	3,551,724	3,772,725	1,096	9%	27%	54%	9%	172,397	536,531	552,427	2,290,369	69.3%	0.0484	0.1247
62	3,550,978	4,032,666	1,133	13%	26%	48%	13%	203,856	578,949	414,166	2,354,006	72.0%	0.1198	0.1328
63	3,551,809	4,350,033	1,177	6%	28%	58%	8%	266,187	498,220	398,058	2,389,345	74.8%	0.2157	0.1432
64	3,550,740	4,683,853	1,221	8%	29%	52%	11%	284,377	673,330	402,344	2,190,688	69.7%	0.1557	0.1688
65	3,552,374	5,060,758	1,269	10%	27%	53%	10%	244,656	467,135	473,685	2,366,898	73.5%	0.1764	0.1788
66	3,549,533	5,418,256	1,313	10%	25%	52%	14%	286,381	605,347	417,333	2,240,472	71.2%	0.1765	0.1659

Table 9: Selected Statistics by Class Using Method B for All Occupied Housing Units

Class	Housing Units	Average Area (m^2)	Derived Radius (m)	Blocks	Block Groups	Tracts	ZCTAs	AHS Response/GIS Determination Yes/Yes	No/Yes	Yes/No	No/No	Percent Agree	Kappa Coeff.	Smooth Kappa
67	3,552,450	5,829,364	1,362	8%	28%	46%	18%	330,254	729,755	392,401	2,100,040	68.4%	0.1696	0.1563
68	3,550,654	6,307,479	1,417	9%	27%	45%	20%	298,971	733,850	386,079	2,131,755	68.5%	0.1511	0.1522
69	3,552,106	6,836,571	1,475	7%	26%	45%	23%	331,254	823,568	450,434	1,946,850	64.1%	0.1080	0.1400
70	3,550,649	7,428,593	1,538	5%	28%	46%	21%	334,822	772,439	393,342	2,050,045	67.2%	0.1560	0.1230
71	3,552,884	8,022,909	1,598	6%	27%	43%	24%	307,469	805,794	419,158	2,020,463	65.5%	0.1153	0.1061
72	3,550,282	8,746,589	1,669	5%	24%	39%	33%	276,615	847,487	412,779	2,013,401	64.5%	0.0847	0.1104
73	3,552,476	9,521,904	1,741	4%	28%	35%	32%	288,356	884,485	442,074	1,937,561	62.7%	0.0664	0.0949
74	3,550,191	10,335,667	1,814	4%	26%	40%	30%	326,236	821,400	401,035	2,001,520	65.6%	0.1298	0.1045
75	3,552,858	11,246,662	1,892	4%	25%	37%	34%	273,267	849,737	420,544	2,009,310	64.2%	0.0783	0.1177
76	3,551,343	12,258,202	1,975	2%	26%	33%	39%	425,518	832,735	428,230	1,864,860	64.5%	0.1633	0.1277
77	3,550,172	13,267,068	2,055	2%	22%	34%	43%	387,269	916,748	358,601	1,887,554	64.1%	0.1509	0.1250
78	3,550,416	14,341,750	2,137	4%	19%	32%	45%	356,377	950,065	375,368	1,868,605	62.7%	0.1162	0.1309
79	3,553,358	15,433,165	2,216	3%	21%	30%	47%	334,677	827,519	434,636	1,956,526	64.5%	0.1163	0.1202
80	3,551,771	16,553,973	2,295	1%	19%	27%	53%	297,469	872,296	376,629	2,005,377	64.8%	0.1078	0.1241
81	3,551,324	17,685,221	2,373	1%	22%	24%	53%	393,163	953,544	420,005	1,784,611	61.3%	0.1099	0.1039
82	3,548,644	18,882,424	2,452	1%	19%	24%	56%	456,600	1,023,338	309,802	1,758,905	62.4%	0.1705	0.0997
83	3,553,685	20,165,250	2,534	1%	19%	26%	55%	286,909	1,056,413	442,251	1,768,113	57.8%	0.0148	0.1089
84	3,550,143	21,682,064	2,627	1%	20%	22%	57%	437,643	1,246,848	311,765	1,553,887	56.1%	0.0953	0.1115
85	3,552,462	23,304,432	2,724	1%	18%	22%	59%	404,554	987,477	323,458	1,836,973	63.1%	0.1540	0.0993
86	3,550,183	24,994,782	2,821	1%	19%	27%	52%	350,843	1,019,879	315,348	1,864,112	62.4%	0.1230	0.1155
87	3,552,672	26,941,195	2,928	1%	20%	20%	60%	364,671	1,143,301	287,129	1,757,570	59.7%	0.1096	0.1093
88	3,551,524	28,958,104	3,036	1%	20%	22%	57%	346,307	1,167,215	286,078	1,751,924	59.1%	0.0956	0.1026
89	3,551,884	31,071,411	3,145	2%	23%	20%	55%	398,039	1,239,941	346,940	1,566,964	55.3%	0.0643	0.0817
90	3,551,569	33,455,115	3,263	0%	18%	23%	59%	445,577	1,189,596	300,389	1,616,006	58.0%	0.1206	0.0890
91	3,550,935	35,996,274	3,385	0%	20%	21%	59%	316,312	1,420,421	297,528	1,516,674	51.6%	0.0184	0.0834
92	3,548,854	38,862,404	3,517	0%	24%	21%	55%	451,228	1,174,938	264,959	1,657,728	59.4%	0.1460	0.0901
93	3,554,147	42,281,507	3,669	0%	18%	20%	61%	438,036	1,445,165	270,709	1,400,238	51.7%	0.0679	0.0885
94	3,551,464	46,127,146	3,832	0%	20%	26%	54%	430,780	1,469,658	204,898	1,446,127	52.8%	0.0977	0.1079
95	3,551,126	49,796,707	3,981	0%	22%	25%	53%	510,877	1,482,977	208,485	1,348,786	52.4%	0.1123	0.0989
96	3,550,691	54,034,258	4,147	0%	21%	22%	57%	426,235	1,350,567	220,503	1,553,386	55.8%	0.1155	0.1089
97	3,552,568	58,703,124	4,323	0%	19%	24%	57%	376,788	1,509,698	155,945	1,510,138	53.1%	0.1013	0.1042
98	3,548,662	63,743,436	4,504	0%	20%	23%	56%	472,273	1,448,430	197,442	1,430,518	53.6%	0.1177	0.1059
99	3,553,592	69,209,181	4,694	0%	19%	25%	56%	437,596	1,574,915	208,560	1,332,520	49.8%	0.0744	0.1045
100	3,551,945	75,521,187	4,903	0%	17%	22%	60%	447,788	1,509,094	157,397	1,437,665	53.1%	0.1207	0.0940
101	3,550,885	82,706,555	5,131	0%	15%	26%	59%	498,599	1,550,150	183,015	1,319,122	51.2%	0.1084	0.0767
102	3,549,164	89,896,798	5,349	0%	18%	27%	55%	395,309	1,744,193	178,600	1,231,061	45.8%	0.0488	0.0830
103	3,552,572	98,293,652	5,594	0%	19%	30%	51%	417,768	1,628,509	255,052	1,251,244	47.0%	0.0311	0.0740
104	3,551,369	108,566,221	5,879	0%	17%	22%	61%	403,581	1,559,348	143,529	1,444,911	52.1%	0.1062	0.0703
105	3,551,784	118,958,192	6,154	0%	16%	29%	56%	418,806	1,573,908	198,392	1,360,677	50.1%	0.0757	0.0768
106	3,550,025	130,175,425	6,437	0%	13%	19%	67%	512,183	1,875,600	104,195	1,058,048	44.2%	0.0897	0.0858
107	3,552,656	143,724,330	6,764	0%	9%	27%	64%	402,556	1,476,498	217,264	1,456,339	52.3%	0.0811	0.0797
108	3,551,029	158,891,060	7,112	0%	14%	24%	62%	476,122	1,683,637	180,310	1,210,960	47.5%	0.0762	0.0839
109	3,552,285	177,878,083	7,525	0%	8%	29%	63%	415,489	1,736,032	143,513	1,257,251	47.1%	0.0757	0.0825
110	3,550,482	195,015,323	7,879	0%	12%	23%	66%	501,089	1,474,112	235,222	1,340,059	51.9%	0.0967	0.0772
111	3,552,926	216,936,651	8,310	0%	6%	25%	69%	492,306	1,829,413	126,387	1,104,820	45.0%	0.0826	0.0741
112	3,550,120	244,642,836	8,825	0%	9%	31%	60%	426,550	1,836,280	152,559	1,134,731	44.0%	0.0546	0.0581
113	3,552,101	277,539,297	9,399	0%	4%	26%	69%	515,254	2,049,019	102,051	885,778	39.4%	0.0608	0.0562
114	3,551,401	311,686,969	9,961	0%	5%	27%	68%	421,994	2,285,270	138,406	705,731	31.8%	-0.0043	0.0366
115	3,551,820	351,316,076	10,575	0%	4%	27%	69%	447,909	1,733,050	136,002	1,234,859	47.4%	0.0873	0.0512
116	3,550,224	397,550,515	11,249	0%	5%	18%	76%	479,499	2,017,298	226,149	827,278	36.8%	-0.0152	0.0356
117	3,552,767	458,675,178	12,083	0%	5%	28%	67%	493,939	1,607,957	127,214	1,323,657	51.2%	0.1272	0.0250
118	3,549,890	562,730,050	13,384	0%	6%	29%	65%	477,492	2,113,850	202,977	755,571	34.7%	-0.0169	-0.0214
119	3,551,233	793,477,243	15,893	0%	5%	26%	69%	443,966	2,446,500	189,440	471,327	25.8%	-0.0574	
120	3,553,188	2,217,410,809	26,567	0%	9%	39%	52%	517,930	2,200,827	371,238	463,192	27.6%	-0.1446	

I have highlighted the 58th class where the kappa coefficient is maximized.

Figure 7: Kappa Coefficients Using Method B

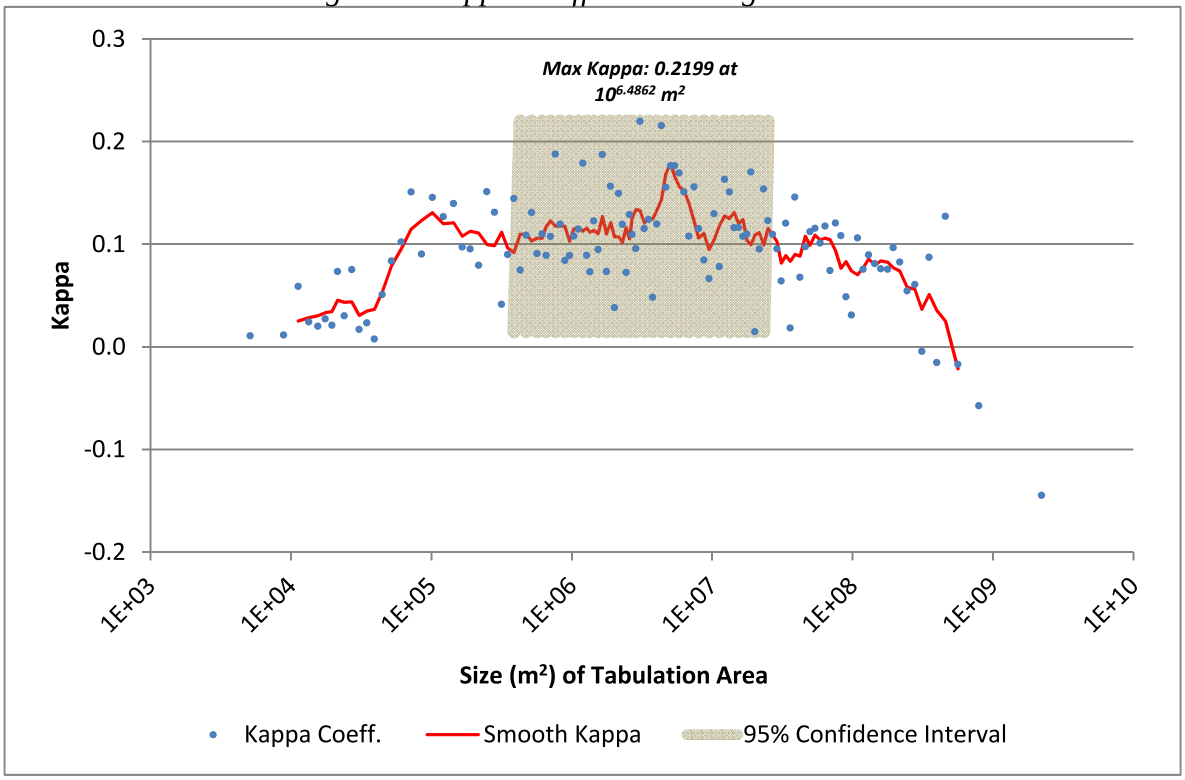


Figure 7 illustrates the data that I have calculated in Table 9. In this figure, I plot kappa coefficients on the vertical axis and the average size of the tabulation area in square meters on the horizontal axis. Notice that the horizontal axis is a logarithmic (base 10) scale – each tick mark indicates an average area that is ten times larger than the previous tick mark. The blue points plotted in Figure 7 are the kappa coefficients calculated in Table 9. The red "smooth kappa" line traces a rolling average of five kappa coefficients:

$smooth\ kappa_i = mean(kappa_{i-2}, \ldots, kappa_{i+2})$ where *i* is a class number between 3 and 118. This smooth kappa line illustrates a clear pattern – the kappa coefficients for the smallest and largest tabulation areas are generally low, and the peak kappa coefficients occur in mid-range tabulation areas. I will refer to the class of tabulation areas where kappa is maximized as the *derived community area*. Using replicate weights, I find that the 95% confidence interval for the derived community area of all occupied housing units using Method B is 370,399 m^2 to 25,339,614 m^2. I indicate this confidence internal by the shaded region of Figure 7. If these upper and lower threshold areas were circles then the derived radius for this range would be 343 m to 2,840 m, which fully overlaps the derived community extent that I previously calculated using Method A (520 m – 1,060 m).

I repeat Method B for the same demographic and socioeconomic groups that I analyzed using Method A in Table 8, and I present these findings in Table 10. Comparing the two tables, I find no statistically significant differences between any of the derived community extents (of Method A) and the derived community areas (of Method B). This conclusion assumes that the shape of the derived community area is a circle and the derived radius measures the distance from the AHS respondent's home to the edge of his or her community. Under this assumption, there is no subpopulation analyzed in Table 8/Table 10 in which the confidence intervals do not overlap at the standard levels for statistical significance.

Additionally, the confidence intervals using Method B are wider than the confidence intervals using Method A for all 50 of the subpopulations analyzed in Table 8/Table 10. In 35 out of the 50 subpopulations, the 95% confidence interval that I derived using Method B completely overlaps (i.e., has a smaller lower bound and a larger upper bound than) the 95% confidence interval using Method A. Based on these observations, I conclude that Method A produces more precise estimates of community size than Method B.

Table 10: Alternate Maximum Kappa Coefficient and the Derived Community Area for Various Characteristics[14]

Characteristic	Derived Community Area (m^2)*				Maximum Kappa Coefficient			
	Point Est.	Std. Error	Lower Bound	Upper Bound	Point Est.	Std. Error	Lower Bound	Upper Bound
All occupied units	6.4862	0.4682	5.5686	7.4038	0.2199	0.0312	0.1588	0.2810
Tenure								
Owner occupied	6.6402	0.8580	4.9586	8.3218	0.2483	0.0399	0.1701	0.3265
Renter occupied	6.4826	1.1143	4.2987	8.6665	0.2630	0.0567	0.1519	0.3741
Race and Hispanic Origin								
White alone	6.6866	1.0974	4.5358	8.8374	0.2287	0.0325	0.1651	0.2923
Non-Hispanic	6.2098	0.8608	4.5226	7.8971	0.2331	0.0397	0.1552	0.3109
Hispanic	6.7342	0.9721	4.8288	8.6395	0.4153	0.1103	0.1992	0.6315
Black alone	5.8067	1.8100	2.2591	9.3542	0.3404	0.0849	0.1741	0.5068
Non-Hispanic	6.0826	1.1314	3.8650	8.3002	0.3308	0.1041	0.1268	0.5348
Hispanic	–	–	–	–	–	–	–	–
American Indian or Alaska Native alone	–	–	–	–	–	–	–	–
Asian alone	6.2825	1.0546	4.2156	8.3495	0.3043	0.3276	-0.3378	0.9464
Pacific Islander alone†	–	–	–	–	–	–	–	–
Two or more races	–	–	–	–	–	–	–	–
Hispanic or Latino (any race)‡	5.6016	1.8792	1.9185	9.2847	0.3645	0.0823	0.2031	0.5259
Units in Structure								
1, detached	6.6446	0.8278	5.0222	8.2669	0.2054	0.0555	0.0968	0.3141
1, attached	5.9507	0.7854	4.4114	7.4901	0.4550	0.1495	0.1619	0.7481
2 to 4	5.8835	0.8562	4.2055	7.5616	0.4907	0.1405	0.2152	0.7661
5 to 9	7.0896	1.9744	3.2198	10.9594	0.2848	0.3769	-0.4539	1.0235
10 to 19	5.6009	0.9683	3.7030	7.4987	0.5911	0.2782	0.0459	1.1364
20 to 49	6.3451	1.4238	3.5545	9.1357	0.5777	0.1687	0.2471	0.9083
50 or more	5.1190	1.0379	3.0847	7.1533	0.5484	0.2060	0.1446	0.9522
Manufactured/mobile home or trailer	6.3190	1.4964	3.3861	9.2519	0.5525	0.3272	-0.0888	1.1937
Cooperatives and Condominiums								
Cooperatives	–	–	–	–	–	–	–	–
Condominiums	5.4258	1.3559	2.7682	8.0834	0.5039	0.2248	0.0632	0.9445
Year Structure Built								
2005 to 2009	6.7932	1.3098	4.2260	9.3603	0.5023	0.2063	0.0979	0.9066
2000 to 2004	6.6104	2.0588	2.5751	10.6456	0.5741	0.2453	0.0934	1.0549
1995 to 1999	6.0937	1.2626	3.6190	8.5684	0.4064	0.1271	0.1573	0.6556
1990 to 1994	4.8626	4.2065	-3.3820	13.1072	0.4878	0.4062	-0.3083	1.2840
1985 to 1989	6.4832	2.5503	1.4846	11.4818	0.4491	0.1341	0.1863	0.7119
1980 to 1984	6.5294	0.9198	4.7266	8.3323	0.4827	0.1181	0.2511	0.7142

[14] The characteristics and categories in Table 10 match the definitions and selection criteria used in Table 2-1, Introductory Characteristics—Occupied Units of *American Housing Survey for the United States: 2009, Current Housing Reports* (March 2011).

Table 10: Alternate Maximum Kappa Coefficient and the Derived Community Area for Various Characteristics[14]

Characteristic	Derived Community Area (m^2)*				Maximum Kappa Coefficient			
	Point Est.	Std. Error	Lower Bound	Upper Bound	Point Est.	Std. Error	Lower Bound	Upper Bound
1975 to 1979	6.3205	0.8916	4.5731	8.0680	0.4281	0.1041	0.2241	0.6321
1970 to 1974	5.5742	1.1198	3.3794	7.7691	0.4098	0.1583	0.0996	0.7200
1960 to 1969	6.5422	1.1855	4.2185	8.8658	0.2971	0.1169	0.0679	0.5262
1950 to 1959	7.4249	1.2899	4.8967	9.9532	0.2929	0.1339	0.0305	0.5553
1940 to 1949	6.6651	0.7442	5.2065	8.1237	0.4216	0.1377	0.1518	0.6914
1930 to 1939	5.8271	1.5374	2.8138	8.8405	0.3685	0.1759	0.0238	0.7132
1920 to 1929	6.4974	1.4892	3.5786	9.4163	0.3965	0.1557	0.0914	0.7016
1919 or earlier	7.8253	2.2802	3.3562	12.2944	0.3994	0.0932	0.2166	0.5821
Metropolitan/Nonmetropolitan Areas								
Inside metropolitan statistical areas	6.6451	0.6940	5.2849	8.0053	0.2048	0.0426	0.1213	0.2882
In central cities	6.2655	1.2177	3.8788	8.6521	0.2820	0.0559	0.1724	0.3916
Suburbs	7.0855	0.9679	5.1885	8.9826	0.2244	0.0737	0.0800	0.3687
Outside metropolitan statistical areas	8.6575	4.0248	0.7691	16.5459	0.4266	0.1191	0.1932	0.6599
Regions								
Northeast	6.0771	0.8861	4.3404	7.8137	0.3029	0.0746	0.1567	0.4492
Midwest	8.6661	1.6266	5.4781	11.8542	0.4125	0.1633	0.0925	0.7326
South	4.9010	1.6947	1.5795	8.2225	0.3569	0.0754	0.2090	0.5047
West	6.8835	0.9764	4.9697	8.7973	0.2945	0.0801	0.1374	0.4515
Place Size								
Fewer than 2,500 persons	6.7795	1.2458	4.3378	9.2211	0.4591	0.3092	-0.1470	1.0651
2,500 to 9,999 persons	5.9092	1.2781	3.4041	8.4143	0.3869	0.1079	0.1753	0.5984
10,000 to 19,999 persons	6.2127	1.4298	3.4104	9.0151	0.3171	0.1544	0.0145	0.6196
20,000 to 49,999 persons	6.7935	0.6988	5.4238	8.1631	0.2716	0.1427	-0.0080	0.5513
50,000 to 99,999 persons	6.0836	1.2473	3.6390	8.5282	0.4407	0.1342	0.1776	0.7037
100,000 to 249,999 persons	6.3832	0.7711	4.8718	7.8947	0.4689	0.0964	0.2800	0.6578
250,000 to 499,999 persons	6.2902	1.6201	3.1148	9.4656	0.3194	0.1811	-0.0355	0.6742
500,000 to 999,999 persons	7.2784	1.7094	3.9280	10.6288	0.5890	0.1607	0.2741	0.9039
1,000,000 persons or more	7.1135	2.7236	1.7754	12.4516	0.3939	0.1631	0.0742	0.7136

* Derived Community Area (m^2) is the value of the exponent with a base of 10, (e.g., $6.4862 = 10^{6.4862} = 3{,}063{,}374$).

† Native Hawaiian and Other Pacific Islander.

‡ Because Hispanics may be any race, data can overlap slightly with other groups. Most Hispanics report themselves as White, but some report themselves as Black or in other categories.

– Indicates a characteristic with too few cases (30 or fewer) to produce useful statistical inferences.

Conclusion

In this report, I used data from the 2009 American Housing Survey in conjunction with various GIS maps and tools to determine that the distance from the typical American's house to the edge of his community is between 520 and 1060 meters. This derived community extent is roughly equal to the radius of one or two median-sized census block groups. Not surprisingly, condo communities and communities with 50 or more housing units per building are smaller than communities of typical single family (detached) homes. I also found a regional variation in community size: communities in the Midwest are larger than those in the South. These findings are not contradicted by an alternative method of deriving neighborhood size that accounts for variations in the neighborhood's shape.

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Appendix A: The Neighborhood Quality Section of the 2009 AHS

GATED
The following questions are about your community.
Is your community surrounded by walls or fences preventing access by persons other than residents?

1. Yes
2. No

    GATEDV
    The following questions are about your community.
    (Last time) we recorded that your community is surrounded by walls or fences preventing access by persons other than residents. Is this information still correct?

    1. Yes
    2. No

ACCESSC
Does access to your community require a special entry system such as entry codes, key cards, or security guard approval?

1. Yes
2. No

    ACCESSCV
    (Last time) we recorded access to your community requires a special entry system such as entry codes, key cards, or security guard approval.
    Is this information still correct?

    1. Yes
    2. No

    ACCESSB
    Does access to your building require a special entry system such as entry codes, key cards, or security guard approval?

    1. Yes
    2. No

    ACCESSBV
    (Last time) we recorded access to your building requires a special entry system such as entry codes, key cards, or security guard approval.
    Is this information still correct?

    1. Yes
    2. No

AGERES

You mentioned that one or more members of your household are 55 or older. Some communities are age-restricted, meaning that at least one member of the family must be at least 55 years or older. Is your development age-restricted?

1. Yes
2. No

AGERESV

(Last time) we recorded that your development was age-restricted, meaning that at least one member of the family must be at least 55 years or older.
Is this information still correct?

1. Yes
2. No

NORC

Sometimes communities that are not age-restricted still attract certain age groups. Do you believe the majority of your neighbors are 55 or over?

1. Yes
2. No

CLUB

Are any of the following features included in your community?
Community Center or Clubhouse?

1. Yes
2. No

GOLF

(Are any of the following features included in your community?)
Golf Course?

1. Yes
2. No

TRAILS

(Are any of the following features included in your community?)
Walking/Jogging Trails?

1. Yes
2. No

SHUTLE

(Are any of the following features included in your community?)
Shuttle Bus?

1. Yes
2. No

CARE
(Are any of the following features included in your community?)
Day Care Center?
1. Yes
2. No

BEACH
(Are any of the following features included in your community?)
Beach, Park or Shoreline?
1. Yes
2. No

Appendix B: Selected Statistics and Tabulation Area Counts by State

State	Area (m^2)	Counts				
		Housing Units	ZCTAs	Census Tracts	Block Groups	Census Blocks
Alabama	135,767,342,446	2,171,853	629	1,181	3,438	252,266
Alaska	1,723,336,523,156	306,967	238	167	534	45,292
Arizona	295,232,869,248	2,844,526	362	1,526	4,178	241,666
Arkansas	137,731,828,968	1,316,299	504	686	2,147	186,211
California	423,966,968,085	13,680,081	1,719	8,057	23,212	710,145
Colorado	269,603,398,884	2,212,898	525	1,249	3,532	201,062
Connecticut	14,357,375,332	1,487,891	391	833	2,585	67,578
Delaware	6,445,769,842	405,885	67	218	574	24,115
District of Columbia	176,999,744	296,719	53	179	450	6,507
Florida	170,311,608,772	8,989,580	1,028	4,245	11,442	484,481
Georgia	153,910,578,723	4,088,801	695	1,969	5,533	291,086
Hawaii	28,312,992,182	519,508	95	351	875	25,016
Idaho	216,443,477,713	667,796	206	298	963	149,842
Illinois	149,995,304,656	5,296,715	1,381	3,123	9,691	451,554
Indiana	94,326,221,957	2,795,541	731	1,511	4,814	267,071
Iowa	145,745,891,267	1,336,417	684	825	2,630	216,007
Kansas	213,099,965,684	1,233,215	561	770	2,351	238,600
Kentucky	104,655,683,036	1,927,164	605	1,115	3,285	161,672
Louisiana	135,656,018,836	1,964,981	571	1,148	3,471	204,447
Maine	91,634,122,036	721,830	432	358	1,086	69,518
Maryland	32,131,089,610	2,378,814	491	1,406	3,926	145,247
Massachusetts	27,335,741,928	2,808,254	331	1,478	4,985	157,508
Michigan	250,486,780,758	4,532,233	987	2,813	8,205	329,885
Minnesota	225,161,404,423	2,347,201	798	1,338	4,111	259,777
Mississippi	125,455,713,880	1,274,719	382	664	2,164	171,778
Missouri	180,540,279,352	2,712,729	1,231	1,393	4,506	343,565
Montana	380,832,074,499	482,825	361	271	842	132,288
Nebraska	200,328,701,612	796,793	654	532	1,633	193,352
Nevada	286,380,145,586	1,173,814	242	687	1,836	84,538
New Hampshire	24,214,215,247	614,754	194	295	922	48,837
New Jersey	22,591,379,380	3,553,562	595	2,010	6,320	169,588
New Mexico	314,917,547,864	901,388	309	499	1,449	168,609
New York	141,296,785,159	8,108,103	1,793	4,919	15,464	350,169
North Carolina	139,390,789,884	4,327,528	833	2,195	6,155	288,987
North Dakota	183,107,810,720	317,498	526	205	572	133,769
Ohio	116,097,706,996	5,127,508	1,224	2,952	9,238	365,344
Oklahoma	181,037,235,141	1,664,378	633	1,046	2,965	269,118
Oregon	254,799,589,926	1,675,562	458	834	2,634	196,621
Pennsylvania	119,280,059,748	5,567,315	1,853	3,218	9,740	421,545
Rhode Island	4,001,234,100	463,388	175	244	815	25,181
South Carolina	82,932,660,230	2,137,683	363	1,103	3,059	181,908
South Dakota	199,728,851,315	363,438	443	222	654	88,360
Tennessee	109,153,130,302	2,812,133	811	1,497	4,125	240,116
Texas	695,661,526,826	9,977,436	2,012	5,265	15,811	914,231
Utah	219,884,162,541	979,709	288	588	1,690	115,406
Vermont	24,906,267,580	322,539	309	184	522	32,580
Virginia	110,786,551,025	3,364,939	826	1,907	5,332	285,762
Washington	184,661,284,315	2,885,677	630	1,458	4,783	195,574
West Virginia	62,756,019,147	881,917	835	484	1,592	135,218
Wisconsin	169,634,848,618	2,624,358	749	1,409	4,489	253,096
Wyoming	253,334,294,812	261,868	177	132	410	86,204
Total†	9,833,536,823,091	131,704,730	32,990	73,057	217,740	11,078,297

† ZCTAs do not cover all areas of the United States; the total area of ZCTAs is 7,592,175,985,321 m^2.
Source: TIGER/Line Shapefiles, 2012, U.S. Census Bureau, Geography Division