

For the past several months the City Council has been working on policy regarding construction of homes on non-conforming building lots. Although it has been recognized for some time the current policy should be reviewed and improved upon, this issue was raised by the Council during the past year after several complaints were received, citing a variety of issues including neighborhood compatibility, stormwater runoff, etc. It has been longstanding City policy to allow construction on non-conforming lots or record so long as certain standards are met. However, applicants with lots greater than 5,000 sq. ft. have not been required to have Planning Board review. Current policy only requires applicants to go before the Planning Board if the lot is less than 5,000 sq. ft. or if it has less than 50 ft. of frontage.

This matter has become more urgent since a recent Superior Court remand to the Planning Board of a case involving a non-conforming lot at 79 Thirlmere Ave. The Court found aggregating two lots to exceed the 5,000 sq. ft. threshold should not preclude the development from Planning Board review. The remand also brought to the City's attention that the Zoning Ordinance contained language inconsistent with longstanding policy regarding net residential density and minimum area per family requirements. Until the ordinance language is amended, it would likely compel the Planning Board and Staff to deny most applications for residential construction on non-conforming lots. When this became apparent, City staff notified pending and prospective applicants that receipt of applications should be temporarily suspended until the broader issue of development on nonconforming lots was addressed by City Council. (Note: The City has since informed prospective applicants that applications will be received, however they should be mindful of the risk their application may not be approved unless the ordinance is amended.)

The City Council initially considered a temporary fix to the ordinance allowing those projects "in the pipeline" to proceed while a more comprehensive fix was developed. On September 7, 2016 the City Council voted down a temporary fix and requested that Staff finalize a comprehensive solution for the Council to consider at an upcoming Workshop. Staff has followed Council guidance and is prepared to present such a comprehensive solution addressing most of the concerns expressed related to current policy on non-conforming lots.

The Planning & Development staff have spent a considerable amount of time researching and developing these recommendations. Staff will be present to discuss these recommendations and answer any questions on Monday evening.



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Interim City Manager

**To:** Don Gerrish, Acting City Manager  
City Council Members

**From:** Tex Haeuser, Planning Director

**Cc:** Planning Board Members, William Laidley, Chairman  
Joshua Reny, Assistant City Manager and Economic Development Director  
Patricia Doucette, Deputy Planning & Development Director and Code Enforcement Officer  
Sally Daggett, Esq.  
Jim Katsiaficas, Esq.  
Steve Puleo, Community Planner  
Jim Thomas, City Assessor

**Date:** September 22, 2016

**Re:** **Comprehensive Recommendations Regarding Minimum Lot Sizes and Nonconforming Lots of Record**

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### **Summary**

This memo contains the following recommendations. Taken together, they would result in a more rational division between the classification of lots as conforming or nonconforming, and they would preserve an ability to build on nonconforming lots while tightening the requirements to do so. Fewer nonconforming lots will be allowed to be developed under the proposed amendments than is true today, and the degree of neighborhood compatibility will be improved.

1. Reduce the Residential A zone minimum lot size from 12,500 sf to 7,500 sf.
2. Create a new zone, Residential A-2, that keeps the existing minimum lot size of 12,500 sf for the A zone portion of the Country Gardens and Highland neighborhoods.
3. Leave the 20,000 sf minimum lot size Residential AA zone as is for the Stanwood Park and Highland neighborhoods.
4. Create a new zone for the Loveitt's Field and Ocean Street neighborhoods, Residential AA-1, that reduces the 20,000 sf minimum lot size to 12,500 sf.
5. Continue to use a maximum net residential density of 4 dwelling units per acre and a minimum area per family of 10,000 sf for the Residential A and AA zones and also for the new Residential A-2 and Residential AA-1 zones. At the same time, make explicit that maximum net residential density and minimum area per family are only applicable to new subdivisions.
6. Require all nonconforming lot applications to obtain Planning Board approval.
7. Prohibit basements for nonconforming lots in combined sewer areas.

8. Codify Planning Board authority to consider the existence of an abutting developed lot in the same ownership in reviewing nonconforming lot applications.
9. Require a 12-foot separation of new buildings on nonconforming lots from existing buildings.
10. Remove the ability to adjust lot lines in the development of nonconforming lots, even if doing so results in less nonconformity.
11. Prohibit easements for buildings or parking on abutting lots in the development of nonconforming lots.

## **Introduction**

In connection with ongoing policy discussions regarding the construction of single-family homes on nonconforming lots of record, the City Council has requested, in addition to temporary, short-term actions, a comprehensive approach to improving nonconforming lots provisions in the Zoning Ordinance and better matching them with current realities and objectives of the City.

I previously have provided background information about the nonconforming lot provisions in Sec. 27-304, their evolution and history, issues related to how they are working, the fundamental problem caused by imposing minimum lot size requirements grossly larger than the sizes of lots in existing single-family neighborhoods, and the dilemma posed by the Thirlmere court case.<sup>1</sup> This memo addresses the minimum lot size situation and recommends a package of amendments that taken together would preserve the value of nonconforming lots of record for their owners while at the same time improving outcomes and providing more compatibility between infill homes and surrounding properties.

## **Comprehensive Plan on Lot Sizes**

The need to review lot size regulations was addressed in the 2012 Comprehensive Plan. In the Land Use Goals and Policies section of the Plan, it says:

The City's established residential neighborhoods are one of its major assets. These neighborhoods offer a range of residential environments and housing styles. Currently the City's zoning regulations make many of the lots and homes in these neighborhoods nonconforming with respect to lot sizes and setbacks due to outdated requirements.<sup>2</sup>

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<sup>1</sup> See: binder with information on nonconforming lot construction since 2007; May 18 memo on *Policies Related to the Treatment of Single-Family Residential Parcels that are Nonconforming with Respect to Lot Size*; PowerPoint *Nonconforming Lots Presentation 7-25-16*; and, August 26 *Planning Board Memo to City Council on Proposed Nonconforming Lots Amendments*.

<sup>2</sup> 2012 South Portland Comprehensive Plan Update, p. 6-8.

Similarly, under Issues and Implications, the Plan states:

Most new single-family residential development in South Portland's Intown and Main Street areas has been on existing lots of 10,000 SF or less, which in many cases would be considered nonconforming if the lots did not already exist. The City should consider altering lot size and other dimensional requirements in these areas.<sup>3</sup>

There is support, therefore, in the Comprehensive Plan for re-examining the City's policies regarding minimum lot sizes and how they interact with the nonconforming lot provisions.

### **Revising Minimum Lot Sizes**

The focus of the minimum lot size analysis is on the Residential AA and A zoning districts. These are the single-family zones with large minimum lot sizes (20,000 sf and 12,500 sf respectively); the other residential zones have minimum lot size requirements of 7,500 sf or less.

The approach to analyzing lot sizes was to use the City's Geographic Information System (GIS) to develop a map and spreadsheet of lots with single-family homes, by neighborhood. Thanks to work by City Assessor Jim Thomas (parcel data) and Community Planner Steve Puleo (GIS map), this resulted in the map of *South Portland Lots Containing Single-Family Homes*. In addition to the single-family home lots, this map has tables that compare the actual average (mean) and median lot sizes of single-family house lots, by neighborhood, as compared with the ordinance requirements.

From this point forward the analysis uses median lot sizes (equal number of lots above and below when the lots are ordered from smallest to largest) in order to reduce the influence that abnormally large or small parcels can have on the mean.

One can tell quickly from looking at these tables on the map that the actual, existing median lot size does not approach the 20,000 sf required for Residential AA in any neighborhood, and only in two neighborhoods do the median lot sizes approach or exceed the 12,500 sf minimum of the Residential A zone.

A close-up of a portion of the Thornton Heights neighborhood gives some insight into the size of lots in the established neighborhoods. In the graphic entitled *Example from Thornton Heights of Current Parcels (in Red) Compared with the Original Lots of Record (in Black)*, the existing (red) lot lines overlay lot lines from the 1945 Country Club Heights subdivision. Most of the lots in the subdivision are 30' x 100' or 3,000 sf, and it is apparent that many of the existing lots are made up of 2, 3, or 4 of these 3,000 sf lots. In other words, almost none of the existing parcels in this area of Thornton Heights consist of the 5 or more Country Club Heights

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<sup>3</sup> 2012 South Portland Comprehensive Plan Update, p. L-8.

lots that would be needed to meet the neighborhood's Residential A zoning minimum lot size of 12,500 sf.

The next step in the analysis is represented by the table called *Summary of Median Lot Sizes, by Neighborhood and Zoning District, for Lots with Single-Family Homes*. The purpose of this table is to look beyond the median lot size by neighborhood to the median lot size for each neighborhood's portion of the Residential A and AA zones. In looking at the distribution of the zones, most of the City's neighborhoods have some Residential A zoning, four neighborhoods have both Residential A and AA zones, and one neighborhood, Loveitt's Field, has only the AA zoning.

What stood out to me from this table were the difference of the Country Gardens and Highland neighborhoods' Residential A median lot sizes from the others, on the one hand, and, among the Residential AA median lot sizes, the split between Highland and Stanwood Park (larger lot sizes) from Ocean Street and Loveitt's Field (smaller lot sizes).

These results led to the two-page table—*Existing and Proposed Residential A and AA Zones, Lot Sizes, and Density*. Based on the median lot sizes and their groupings, this table lays out the following recommendations:

1. Reduce the required minimum lot size in the Residential A zone from 12,500 sf to 7,500 sf. For the 11 neighborhoods affected by this change, the Residential A zone median lot sizes range from 5,999.9 sf in Pleasantdale to 8,505.9 sf in Meadowbrook. This is a tight range with 7,500 sf being very much in the middle.
2. Create a new zone, Residential A-2 (there already is a transitional A-1 zone along part of southern Highland Avenue), for the A zone portion of Country Gardens and Highland. This is necessary in order to keep the minimum lot size for the A zone in these two neighborhoods at 12,500 sf given that their median actual lot sizes are 12,420.2 and 13,418.4 respectively.
3. Create a new zone for Loveitt's Field and Ocean Street, Residential AA-1, in order to reduce the AA minimum lot size for these neighborhoods from 20,000 to 12,500 sf. In this case the spread of the existing median lot sizes is wider—from 8,386.5 sf for Loveitt's Field to 13,568.0 sf for Ocean Street. It seemed better, however, to have a single zone with a somewhat wider spread than to further complicate the zoning map with separate zones for each neighborhood.
4. Leave as is the Residential AA zone in the other two neighborhoods, Highland and Stanwood Park, given that their median lot sizes of 20,943.1 sf and 24,641.7 sf are close to the 20,000 sf ordinance minimum.
5. For both the Residential A and AA zones (and the proposed A-2 and AA-1 zones), leave as is the maximum net residential density of 4 dwelling units per acre and the minimum

area per family of 10,000 sf. (These only apply in the AA zone to lots not on public sewer.) Assuming the recommendation below to make explicit that these standards only apply to new subdivisions (including cluster development) is adopted, keeping these values the same has no effect compared to the status quo. Logically, for the two instances above in which lot sizes are proposed to be reduced, there should be a corresponding decrease in the maximum density and minimum area per family requirements for new subdivisions. However, there are few opportunities for subdivisions left, so the point is mostly moot, and it may not be worth adding more changes to the Zoning Ordinance.

### **Effect of the Zone and Minimum Lot Size Changes**

Making the changes described above, which in terms of the new zones is depicted in the *Existing and Proposed Residential A and AA Zoning Districts* map, would have the effect of bringing the required minimum lot sizes for the Residential A and AA zoning districts much closer to the actual sizes of lots with single-family homes in the various neighborhoods in which these zones are located. With the City now largely built out, this is an appropriate time for bringing these values into approximate equivalence. Doing so means that there will be fewer nonconforming lots—the proposed new minimum lot size for the Residential A zone of 7,500 sf compares with 7,359.9 sf for the Residential A zone median lot size across all neighborhoods and with 7,499.9 sf for the City-wide median lot size for all lots with single-family homes. There still will be nonconforming lots—after all, half the single-family lots in the City are less than 7,500 sf in size—and there, therefore, will still be a need for the additional changes to the nonconforming lot provisions described below. But with these zoning amendments there at least will be a better fit between the lot sizes required by ordinance and the sizes of lots found in any given neighborhood, and there will be more confidence that arbitrary rules aren't in use that artificially classify lots that are typical of a neighborhood as being substandard and ineligible for full land use rights.

### **Recommendations for Revising the Nonconforming Lot Provisions**

In addition to the zoning districts and minimum lot size changes, the following amendments to the nonconforming lots provisions of the Zoning Ordinance (Sec. 27-304) are recommended:

1. Extend the requirements for Planning Board review under Sec. 27-304(g) to all nonconforming lot applications. (Currently this only applies to lots with less than 5,000 sf or with less than 50 feet of frontage.) This will bring greater scrutiny to bear on stormwater runoff, compatibility with the surrounding neighborhood, and similar matters. It also will ensure that residents in the neighborhood get a chance to come to a public hearing to air their views and help educate the Board about the neighborhood and the factors that should be considered in applying the compatibility tests. The substantial costs to prepare a Planning Board application and to go through a public hearing are

outweighed by the need to ensure a good fit of homes on nonconforming lots with their neighbors.

2. Prohibit homes being proposed for nonconforming lots in combined sewer areas from having basements. The safety valve of tying into the City's stormwater system doesn't exist in combined sewer areas, so preventing homes in these areas from needing sump pumps that potentially could tap into the water table can be accomplished by having the homes be built on slabs without basements.
3. In the case of a nonconforming lot abutting a developed lot in the same ownership, make clear that the Planning Board has authority, similar to its authority in subdivision review, to take the existence of the developed lot into consideration as well as the lot for which an application has been filed. This can help, for example, in ensuring that a proper stormwater plan is created for both lots.
4. Make explicit that the maximum net residential density and minimum area per family standards are applicable only to new subdivisions (including cluster subdivisions). As has been described previously, these standards were never meant or understood by the lawmakers who created them, or by the staff who enforce them, to be applicable to nonconforming lots and would almost entirely negate the ability to build on nonconforming lots if imposed. This is one of those situations where we really can't have it both ways: if the City is going to continue in some fashion to allow the construction of single-family homes on nonconforming lots, we can't also require the lots to meet a density limit based on the conforming lot size standard.
5. Add the 12-foot minimum distance between new and existing principal buildings that currently applies in the G zone to the A and AA zones as well. In this case, however, make the distance requirement applicable to accessory structures—like garages—as well as to the principal dwellings. This is to prevent the few unfortunate situations that have occurred in which a new house on a nonconforming lot meets the zoning setbacks but the existing home of the abutting property in common ownership is left with less than the minimum side yard setback and is too close to the new building.
6. Remove the current ability to adjust lot lines of nonconforming lots of record when doing so results in a less nonconforming situation. This means that applicants will have to make do with the current arrangement of lots and lot lines and will not be able to adjust lines to achieve a greater number of homes. In some limited cases, due to the configuration of existing development on abutting nonconforming lots, this will prevent the ability to build a home on a nonconforming lot that would otherwise have been allowed under current rules. The reason for this suggestion is that it sometimes is very difficult to determine whether a revision of lot lines has in fact made a series of lots less nonconforming.

7. For undeveloped nonconforming lots abutting developed lots in common ownership, prohibit the ability of either lot to have an easement on the other lot for a building and/or for a driveway and parking. Each lot should be able to stand on its own in this regard.

### **Conclusion**

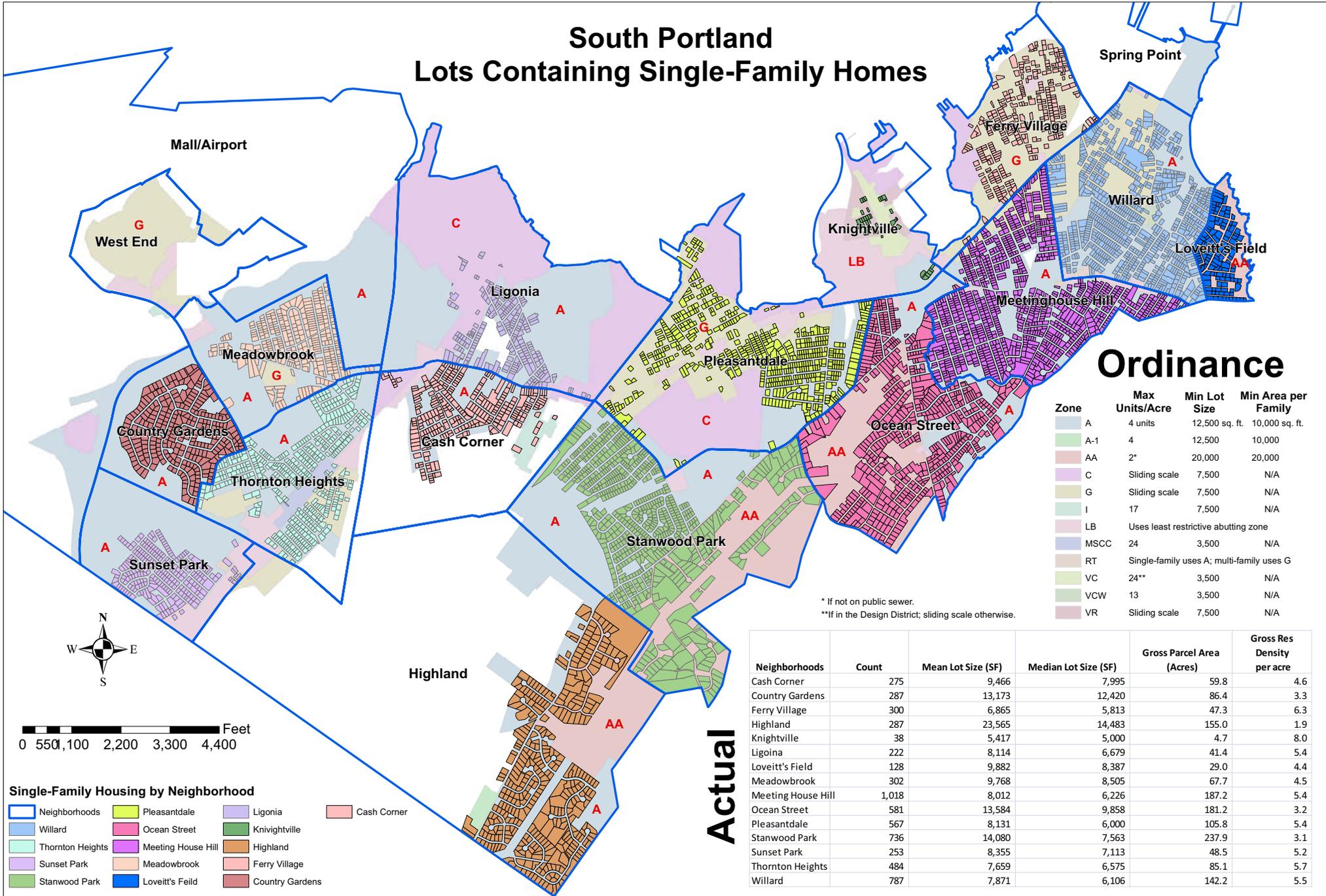
One observation from a resident that has stuck with me came after the resident observed a Planning Board hearing on a sub-5,000 sf nonconforming lot application and compared it with the construction of a home on a nonconforming lot that was larger than 5,000 sf and that didn't have to have Planning Board review. The resident was fairly amazed by how thorough and meticulous the Planning Board was in going over the application in front of them in contrast with the absence of any of that review, other than a drainage plan, for the larger lot. With this in mind, the package of recommended changes to zoning districts, lot sizes, and nonconforming lot provision, if adopted, would bring the minimum lot size requirements into synch with actual neighborhood single-family home lot sizes, would extend the benefits of Planning Board hearings and reviews to all nonconforming lot applications, and would clean up a number of loopholes and contradictions that experience has made apparent.

Thank you.

### **Attachments**

1. Map: *South Portland Lots Containing Single-Family Homes.*
2. Graphic: *Example from Thornton Heights of Current Parcels (in Red) Compared with the Original Lots of Record (in Black).*
3. Table: *Summary of Median Lot Sizes, by Neighborhood and Zoning District, for Lots with Single-Family Homes.*
4. Table: *Existing and Proposed Residential A and AA Zones, Lot Sizes, and Density.*
5. Map: *Existing and Proposed Residential A and AA Zoning Districts.*

# South Portland Lots Containing Single-Family Homes



## Ordinance

Zone	Max Units/Acre	Min Lot Size	Min Area per Family
A	4 units	12,500 sq. ft.	10,000 sq. ft.
A-1	4	12,500	10,000
AA	2*	20,000	20,000
C	Sliding scale	7,500	N/A
G	Sliding scale	7,500	N/A
I	17	7,500	N/A
LB	Uses least restrictive abutting zone		
MSCC	24	3,500	N/A
RT	Single-family uses A; multi-family uses G		
VC	24**	3,500	N/A
VCW	13	3,500	N/A
VR	Sliding scale	7,500	N/A

\* If not on public sewer.  
\*\*If in the Design District; sliding scale otherwise.

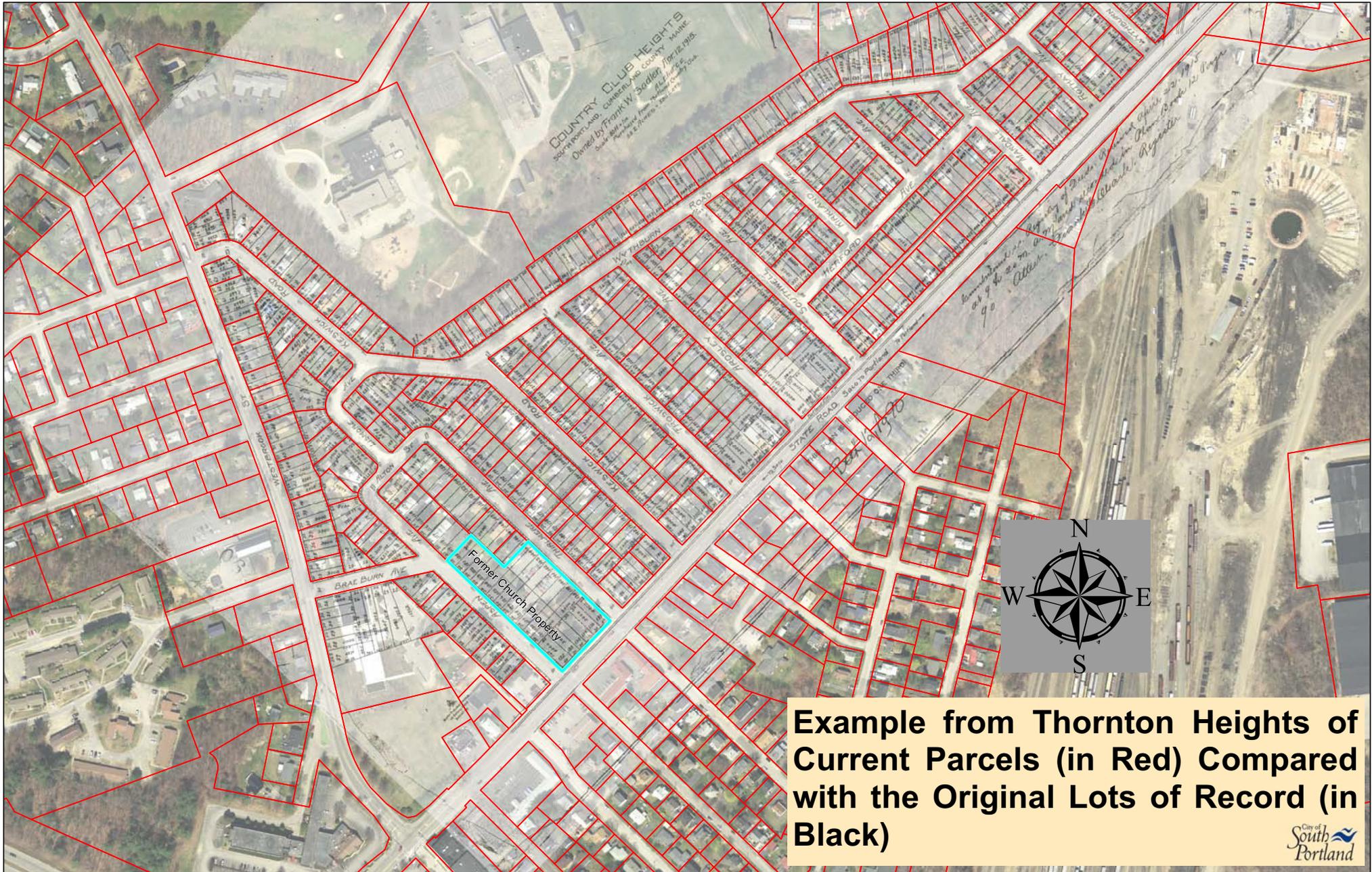
Neighborhoods	Count	Mean Lot Size (SF)	Median Lot Size (SF)	Gross Parcel Area (Acres)	Gross Res Density per acre
Cash Corner	275	9,466	7,995	59.8	4.6
Country Gardens	287	13,173	12,420	86.4	3.3
Ferry Village	300	6,865	5,813	47.3	6.3
Highland	287	23,565	14,483	155.0	1.9
Knightsville	38	5,417	5,000	4.7	8.0
Ligonia	222	8,114	6,679	41.4	5.4
Loveitt's Field	128	9,882	8,387	29.0	4.4
Meadowbrook	302	9,768	8,505	67.7	4.5
Meeting House Hill	1,018	8,012	6,226	187.2	5.4
Ocean Street	581	13,584	9,858	181.2	3.2
Pleasantdale	567	8,131	6,000	105.8	5.4
Stanwood Park	736	14,080	7,563	237.9	3.1
Sunset Park	253	8,355	7,113	48.5	5.2
Thornton Heights	484	7,659	6,575	85.1	5.7
Willard	787	7,871	6,106	142.2	5.5

## Actual

### Single-Family Housing by Neighborhood

- Neighborhoods
- Pleasantdale
- Ligonia
- Cash Corner
- Willard
- Ocean Street
- Knightsville
- Thornton Heights
- Meeting House Hill
- Highland
- Sunset Park
- Meadowbrook
- Ferry Village
- Stanwood Park
- Loveitt's Field
- Country Gardens





COUNTRY CLUB HEIGHTS  
5000 SOUTHWEST CORNER  
Owned by Frank W. Bradley 1912-1915  
Scale: As Shown on Plat of 1915  
1/2" = 100' - 0"

Former Church Property

**Example from Thornton Heights of Current Parcels (in Red) Compared with the Original Lots of Record (in Black)**



**Summary of Median Lot Sizes, by Neighborhood and Zoning District, for Lots with Single-Family Homes**

<b>Neighborhood</b>	<b>Res A Zone Median Lot Size</b>	<b>Res AA Zone Median Lot Size</b>	<b>All Zones Median Lot Size for Lots with SF Homes</b>
Sunset Park	7,086.9	N/A	
Country Gardens	12,420.2	N/A	
Meadowbrook	8,505.9	N/A	
Thornton Heights	6,807.5	N/A	
Ligonía	6,700.0	N/A	
Cash Corner	7,990.3	N/A	
Highland	13,418.4	20,943.1	
Stanwood Park	6,913.4	24,641.7	
Pleasantdale	5,999.9	N/A	
Knightville	7,588.7	N/A	
Ocean Street	7,882.7	13,568.0	
Meetinghouse Hill	6,160.7	N/A	
Willard	6,007.2	N/A	
Loveitt's Field	N/A	8,386.5	
<b>Overall Res A Zone Median Lot Size</b>	<b>7,359.9</b>		
<b>Overall Res AA Zone Median Lot Size</b>		<b>16,580.5</b>	
<b>Overall Median Lot Size for All Lots with SF Homes</b>			<b>7,499.98</b>

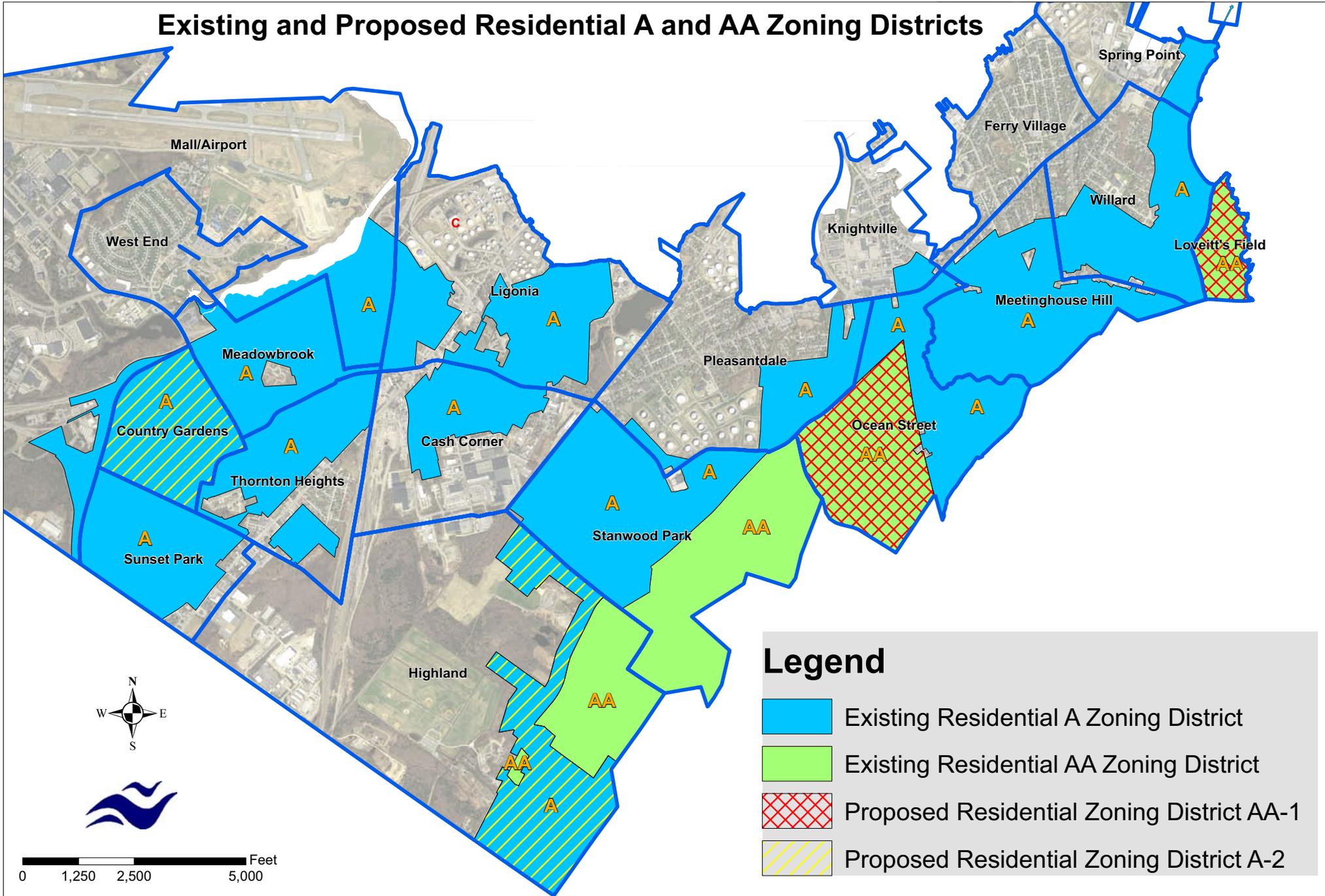
## Existing and Proposed Residential A and AA Zones, Lot Sizes, and Density

Residential A Zone					
Neighborhoods with Residential A Zoning	Existing Median Lot Size (sf)	Proposed Minimum Lot Size	Proposed Maximum Net Residential Density	Proposed Minimum Area per Family	Zoning District
			(Exclusively for new subdivisions)	(Exclusively for new subdivisions)	
	Overall = 7,359.9 sf	Current = 12,500 sf	Current = 4 units per acre	Current = 10,000 sf per family	
Pleasantdale	5,999.9	7,500 sf	4 units / acre	10,000 sf / family	Continues as the Residential A zoning district the same as currently shown on the Zoning Map and with the same standards except for the minimum lot size as shown here.
Willard	6,007.2				
Meetinghouse Hill	6,160.7				
Ligonیا	6,700.0				
Thornton Heights	6,807.5				
Stanwood Park	6,913.4				
Sunset Park	7,086.9				
Knightville	7,588.7				
Ocean Street	7,882.7				
Cash Corner	7,990.3				
Meadowbrook	8,505.9				
Country Gardens	12,420.2	12,500 sf	4 units / acre	10,000 sf / family	Changes to a new zoning district -- Residential A-2 -- but keeps all its current standards, including the current minimum lot size.
Highland	13,418.4				

## Existing and Proposed Residential A and AA Zones, Lot Sizes, and Density

Residential AA Zone					
Neighborhoods with Residential AA Zoning	Existing Median Lot Size (sf)	Proposed Minimum Lot Size	Proposed Maximum Net Residential Density	Proposed Minimum Area per Family	Zoning District
			(Exclusively for new subdivisions)	(Exclusively for new subdivisions)	
	Overall = 16,580 sf	Current = 20,000 sf	Current = 2 units per acre (if not on public sewer)	Current = 20,000 sf per family	
<b>Loveitt's Field</b>	<b>8,386.5</b>	<b>12,500 sf</b>	<b>2 units per acre (if not on public sewer)</b>	<b>20,000 sf per family</b>	<b>Changes to a new zoning district -- AA-1 -- with the only change being to the minimum lot size.</b>
<b>Ocean Street</b>	<b>13,568.0</b>				
<b>Highland</b>	<b>20,943.1</b>	<b>20,000 sf</b>	<b>2 units per acre (if not on public sewer)</b>	<b>20,000 sf per family</b>	<b>Continues as the Residential AA zoning district with no changes.</b>
<b>Stanwood Park</b>	<b>24,641.7</b>				

# Existing and Proposed Residential A and AA Zoning Districts



**The following documents are  
submitted by:**

**E. Rose, City Councilor, Dist. 3  
South Portland, Maine**

## PROPOSED RESIDENTIAL DENSITY CALCULATION BASED ON VIEWSHED PROTECTION

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Proposed by E. Rose, City Councilor, Dist. 3  
South Portland, Maine, Sept. 26, 2016  
for workshop on nonconforming lots

Q: Why have residential density limits?

A: To “promote a wholesome living environment”

Q: What does this mean?

- no overburdening of public infrastructure
  - allowing access to emergency services
  - to guard against flooding and water table drawdown
- } These are the subjects of site plan review
- to ensure retention of green space and prevent overdevelopment
  - to protect viewsheds

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### There are no universal methods for calculating residential density.

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Below are some examples of ways residential density is calculated across the US:

- **Block Density (BD)**– Uses 2000 U.S. Census Data to identify acreage of census blocks and divides this by the number of residences per block;
- **Parcel Density (PD)**– residences per parcel area as a fraction of per-acre density;
- **Neighborhood Density, as Net (NND) or Gross (GND)**– uses defined neighborhood (e.g., Meeting House Hill) as basis for calculating residences per acre;
- **City Density (CD)**– total city residential area divided by number of residences (compare to cluster development at smaller scale )

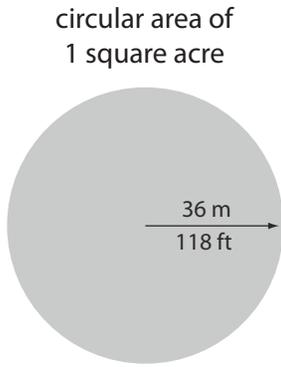
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The proposed method for calculating residential density focuses on viewshed protection and, by extension, protection of greenspace.

The basic concept here is to float a circle of 1 square acre in area (radius 118 ft. = 36 m) over a proposed building site to see if it captures the allowable limit of houses per acre for that zone. This area is GROSS, not net. The rationale is that viewsheds are preserved over undeveloped land and public land that would be excluded from the calculation of NET acreage.

**Where to center the circle?** One suggestion is to float the circle to circumscribe the optimum buildable area within a lot. A more blunt approach would be to extend a 118 ft. (36m) buffer around the required setback of each lot and see how many houses are captured in that area.

Marginal cases, such as where a small sliver of a house is touched by the circle can be addressed in a number of ways, including a mini-site plan review for buildability.

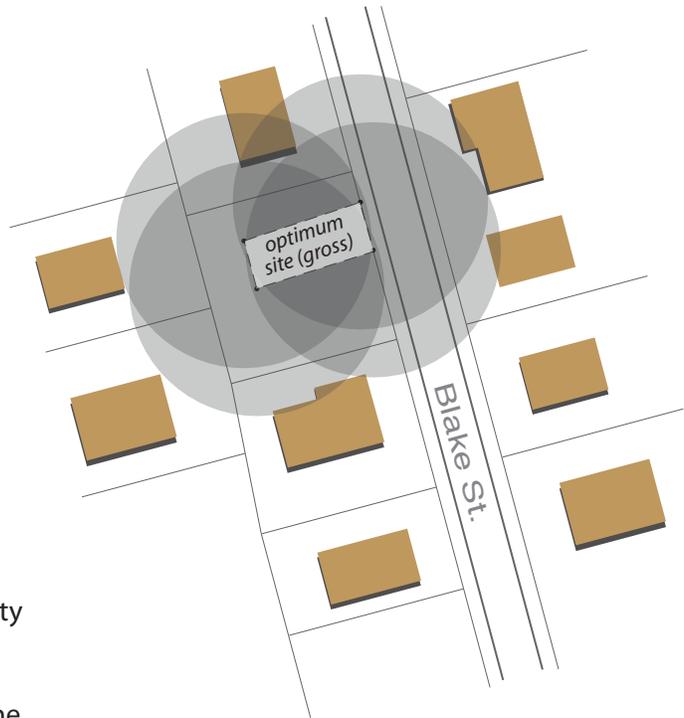


A 36 m radius of a circle is what can be viewed from the vantage point in all directions of the circle to take in one acre of area.

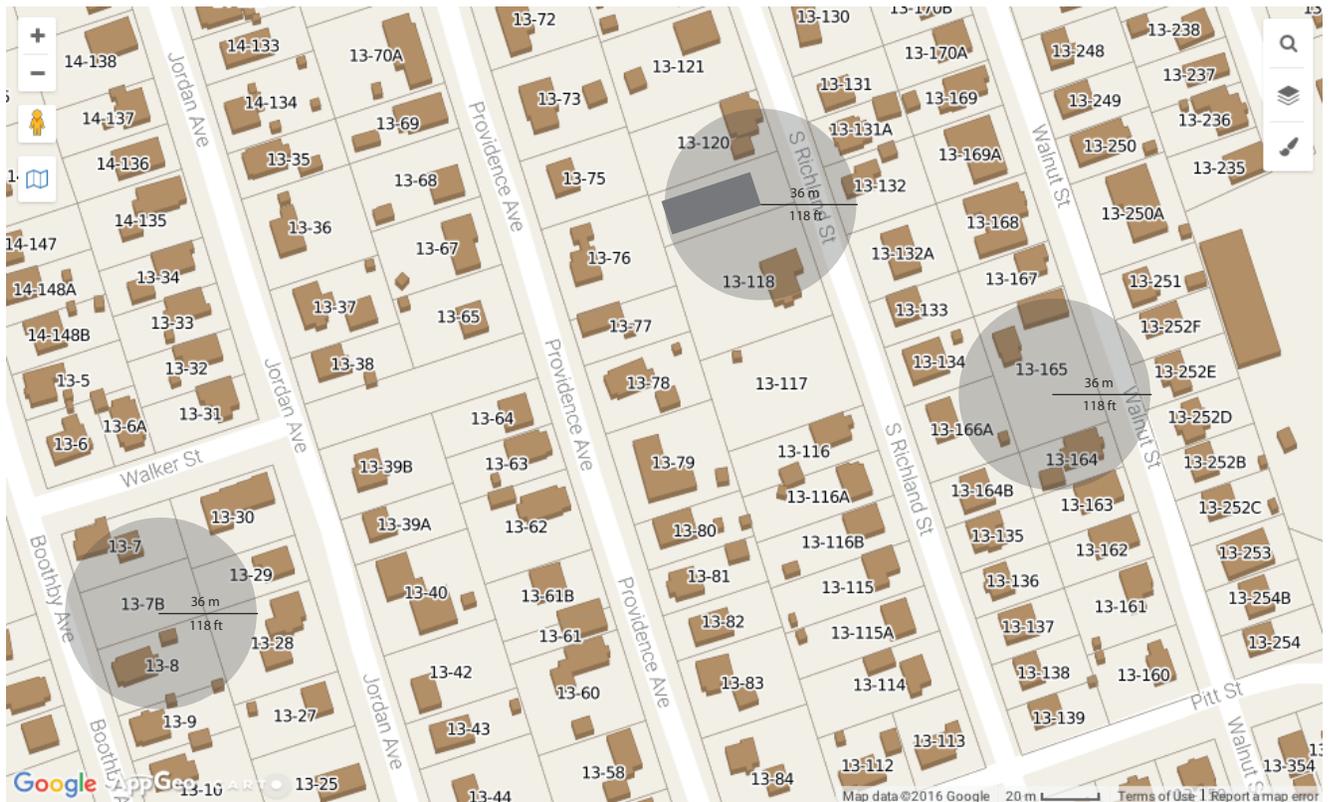
That center can then be moved around to all vantages within a lot that do not exceed density requirements.

As the circle is moved in all directions where the density limit applies, the center traces an outline of the optimum (gross) building site.

Subtracting setbacks and bulk requirements yields the optimum (net) net building site.



This process can be automated using the City GIS to yield a comprehensive map for optimum building sites citywide that retain residential density based on viewshed protection.



**Design Center for American Urban Landscape**  
Design Brief, Number 8/ July 2003

# Measuring Density: Working Definitions for Residential Density and Building Intensity



Ann Forsyth, Director

November 2003

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UNIVERSITY OF MINNESOTA

# Measuring Density: Working Definitions for Residential Density and Building Intensity

Ann Forsyth, Director

## Overview

Density is a controversial term. Increased density is feared by those who imagine ugly buildings, overshadowed open space, parking problems, and irresponsible residents. It is promoted by those who value urbane streetscapes, efficient infrastructure supply, walkable neighborhoods, and increased housing options.

However, within these debates is a surprising lack of clarity about what counts when considering density, and about how to measure it. This design brief outlines a number of general considerations in measuring density and then proposes twenty measures that quantify different aspects of place such as residential population and dwelling density, and the intensity of building on a site. Some of the measures are easy to use in practice, and some more difficult. All focus on residential areas. While some can be applied to other kinds of uses of land the translation is not always direct. Indicators of density in mixed use environments are particularly lacking.

## Key Points

- Density is a number of units--people, dwellings, trees, square feet of building--in a given land area.
- Density varies greatly depending on the base land area used in the density calculation. The parcel or site density is almost always higher than the neighborhood density, because at a neighborhood scale much land is included in the base land area calculation that does not have houses.
- Population density depends on both dwelling unit density and household size. Given a certain dwelling unit density, the population density will be lower with small households such as empty nesters than with large families with several children.
- Intensity of building development is measured with several physical indicators related to how much built area there is on the site. Most measure building bulk and are quite crude. More important issues of design quality are much more difficult to quantify.

**For more detail, supporting facts, and references read on.....**

## Terminology

Density is a much used term. At its simplest, **density is a number of units in a given area.** However, there are no agreed-upon standard definitions of density, rather each location and profession has come up with an idiosyncratic view.

A key area of difference and confusion is in the **base land area calculation**—what is included and what is excluded to make density figures truly comparable. Is it only the site or the entire neighborhood? This is the key dimension of variation in the range of density definitions in Part A of the working definitions section of this paper. Practically it results in a huge variation in density as can be seen below in the table. These densities are for a hypothetical site set in an area where each residential area has the same site density in dwelling units (DUs) per acre but different density definitions lead to very different measures. (The different kinds of density are explained in the next section.)

**Table: Comparison of Density Measures for the Same Location**

Site density	10 DUs per acre
Block density	8 DUs per acre
Net residential density	10 DUs per acre
Net neighborhood density	6 DUs per acre
Gross neighborhood density	5 DUs per acre
City density	4 DUs per acre
Metropolitan density	3 DUs per acre

The difference between these numbers is that as the base land area being considered increases there are more and more nonresidential uses added into the calculation. These nonresidential uses such as offices and open space have residential densities of zero and thus lower average

residential densities across these wider areas. These more inclusive densities are important measures and have much to say about such issues as the overall walkability of the site. Given these figures, however, if an overall aim is to achieve a city density of 4 dwelling units per acre then the site density will need to be much greater.

Similarly, **household size affects population density.** An area with a site density of 10 DUs per acre may have a site population density of 15 people per acre in an area full of empty nesters and seniors, or a site population density of 35 people per acre in an area with many households with children or extended families. This makes a great deal of difference in terms of how many people are present to support community facilities. However, it is much harder for governments to regulate household size as opposed to dwelling numbers so most policy discussions focus on densities of dwelling units.

One area of confusion is between density and other related terms. On one side are **physical measures of the intensity of use of land** including measures of building bulk and coverage. A number of such measures are listed in Part B of the working definitions section. These measures say something about how big the buildings are, although they are only rough measures.



Large setbacks are not always attractive. Large areas devoted to the automobile can also force the neighborhood and city level densities down, even when the residential areas have many dwellings on a small amount of land. Photo: DCAUL



Photo: Ann Forsyth

Beacon Hill in Boston is an area where high lot coverage and small setbacks combine to make a high quality environment.

Many of the most charming environments in the world have buildings with small setbacks, high building coverage, and relatively small distances between buildings. More open space is not necessarily better, particularly when such open space is poorly designed.

Another area of confusion is the issue of **crowding**, which is a perception that there are too many people (Churchman 1999). However, in housing studies crowding is generally operationalized as the number of people per room, per bedroom, or square foot. Obviously density and crowding are not the same and are not even related. It is possible to live at very high density in a spacious apartment with no crowding, and conversely it is possible to live in a detached farm house that is crowded in terms of having many people per room.

In addition there is **unclear terminology even when it appears to be specific**. Net density refers to densities where the base land area calculation focuses only on the parcel or, if covering a larger

areas, excludes certain uses. Gross densities do not have such exclusions. However, as is obvious from the set of working definitions **there are a number of “net” and “gross” density definitions** and so what area is being considered needs to be specified. Saying net or gross is not enough.

While people often talk about low, medium, and high densities **there are no agreed upon standards for what constitutes high, medium, and low densities**. A high density in Minneapolis might be medium or even low density in Paris or Singapore.

Often people **confuse density with building type** and assume, for example, that detached houses are lower density than attached housing types. While this is generally true it is not always the case. A high-rise tower with large units set on a park-like site may be lower density than a set of detached houses on small lots.

A larger question is that of **perceived density** (Rapoport 1975). Perceived density is not highly related to actual density but is profoundly affected by landscaping, aesthetics, noise, and building type. Often, when people say an area is dense, they base this assessment on a perception that a development is ugly, has little vegetation, and has caused parking problems for neighbors, rather than a count of the actual number of units per acre. Design can make an enormous difference to perceived density.

Finally, some people associate higher densities with **social and economic characteristics** such as renter and low-income households, and high crime neighborhoods. They may misperceive densities because of this, underestimating the densities of more affluent areas with larger numbers of owners. The definitions in this paper will help add clarity to such discussions.

## Working Definitions

A range of potential density definitions is outlined below, based on a review of the work in the reference list, general knowledge of density calculations used in urban design regulations, and unique measures developed for Design Center projects. (See the <http://www.designcenter.umn.edu> for examples.)

The ones most used by the Design Center are marked with an \*. Those developed by the Design Center are indicated although it is likely that these definitions have been created earlier by others and we welcome correspondence indicating those uses. We will cite them in subsequent editions of this paper.

Many of these density measures are simple to calculate but some are quite difficult and need a large team of workers.

### Part A. Dwelling unit (DU)/residential population (RP) densities

#### Parcel or block densities (all “net” densities)

\*1. *Parcel Density (PD): DUs or RP divided by total site/parcel area (all uses).* This is often used by developers. It is easy to calculate with GIS but also fairly simple by hand if there is only one parcel. However, since parcel boundaries are not always visible on the ground this form of density can be hard to calculate from physical observations.

\*2. *Block Density (BD): DUs or RP divided by block area measured to the curb.* This is relatively easy to measure from aerial photos and census data, and reflects a unit that is part of the experience of place, the block (Design Center). However, if the block is not surrounded by roads, for example where it abuts open space, the boundaries can be less clear.

3. *Part Block Density (parcel approximation) (PBD): DUs or RP divided by a clear subset of the block area measured to the curb.* Sometimes the parcel boundaries are not highly visible and so a part-block density is a useful approximation for a

parcel density. However, it does include the sidewalk area and so will deliver a slightly lower density number than a site/parcel density (Design Center).

#### Neighborhood

4. *Net Neighborhood Residential Dwelling/Population Density (NNRDD/NNRPD): DU or RP divided by total land area devoted to residential facilities.*

This is a calculation that involves defining both a neighborhood and residential land within that neighborhood. Unless there is a truly compelling reason to choose another unit, the *neighborhood* should be a census tract or a city-delineated neighborhood and should be clearly defined; typically these will be in the 100-500 acre ranges.

Care must be taken in assigning land to *residential uses* rather than, say, recreation--the key is to find equivalent elements in different residential designs. In lower density areas the base land calculation typically includes dwelling lots/yards, driveways, private gardens, and ancillary structures e.g. garages. In higher density designs the equivalent base area includes private access drives, resident parking, play spaces, gardens, and landscaped areas adjacent to and related to the residential use. Excluded are the following areas if not directly beneath a dwelling: commercial and industrial areas, shops, commercial garages, public parks/playgrounds, undeveloped vacant land, vacant unsuitable land, schools, churches, public streets, public parking spaces. This calculation is relatively simple using GIS but difficult otherwise. This definition is adapted from Alexander (1993) who has an even more detailed list of exclusions.

5. *Net Neighborhood Residential Building Type Density (NNRBTD). Density calculation very similar to definition number 4 but counts only the dwellings of one type in a neighborhood e.g. townhouses and the land area associated with that type.* This is a relatively simple calculation using GIS, if the appropriate data exist, and like other

densities in this list can be calculated for dwelling units or residential population (Design Center).

6. *Net Neighborhood Density (NND): DU or RP divided by the neighborhood area with the base land area calculated to exclude city-wide uses in the neighborhood. Neighborhoods should be defined as in #4. Included in the neighborhood land area are residential land, streets, and neighborhood type uses—schools, parks, churches/synagogues/temples etc. and neighborhood shopping. Excluded are city-wide businesses, public uses, high schools and colleges, major arterials, major regional parks, and vacant and unusable land. These exclusions can be difficult to calculate (adapted from Alexander 1993). This is different to the Net Residential Densities in that it includes other neighborhood uses while still excluding uses seen as regional.*

\*7. *Gross Neighborhood Density (GND)/Gross Census Tract Density (GCTD): DU or RP divided by the total neighborhood area. The total neighborhood area should be defined as in density definition number 4 but in this case there are no exclusions. This is easy to calculate although it may be skewed by regional uses such as regional parks. The Gross Census Tract Density is particularly useful as it is available across the United States from Census information and does not rely on local data.*

#### City and larger

8. *City Density (CD): DU or RP divided by the entire developed area of the city or town. In built out local government areas this is in practical terms the entire city. On the urban edge, it includes only developed land, a more complex calculation (adapted from Alexander 1993). This is a gross density.*

9. *Metropolitan Density (MD): DU or RP for US Census Metropolitan Statistical Area divided by total land area. This calculation includes undeveloped areas which will lower the overall figures, but is nationally comparable. The US Census prepares*

such density figures. This is also a gross density.

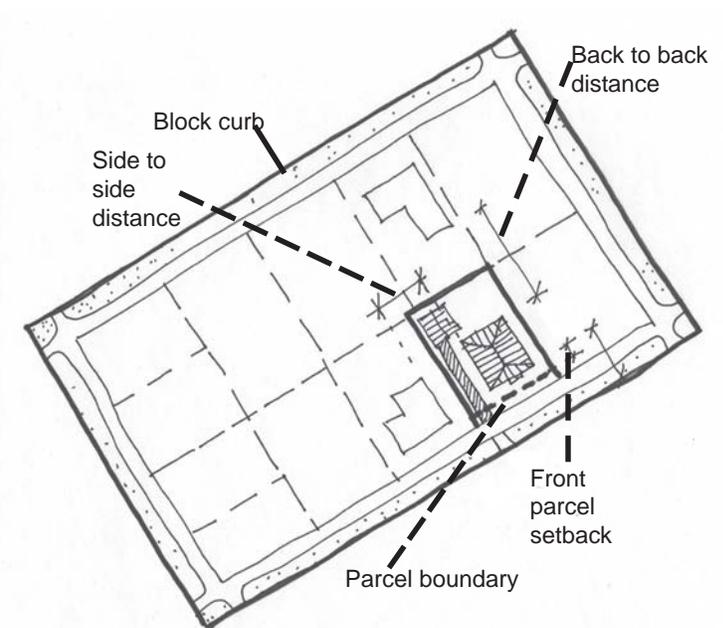
10. *Net Residential Density at City or Metropolitan Level: DU or RP divided by residential land at a City or larger level. This kind of calculation is possible using large Geographical information System databases. The presence of housing in mixed use areas makes it complicated in areas with a large percentage of such areas.*

#### Part B. Built area intensity measures at parcel or block level

11. *Floor Area Ratio (FAR)—Built floor area on all floors divided by the parcel area. This calculation is often based on actual usable floor area rather than footprint area that includes wall thickness. However, this varies from municipality to municipality.*

12. *Building Site Coverage—Area of ground floor footprint of building divided by the parcel area. This measure indicates the amount of open space left on the site.*

\*13. *Building Block Coverage—Area of ground floor footprints of buildings divided by the block area measured to the curb. This is a calculation that can*



Density and building intensity factors on a simplified block.

be done when the parcel boundaries are not known. It also reflects the actual experience of an environment better than parcel by parcel calculations.

*\*14. Impervious Surface Parcel Coverage—Area of ground floor building footprint plus paved parking lots, drives, sidewalks, paths, decks and other buildings divided by site or parcel area. This measure indicates the area of land that has been built upon or paved but does not easily take account of porous paving systems or decks designed for water infiltration.*

*\*15. Impervious Surface Block Coverage—Calculation as for number 14 but using the block as the base land area.*

*16. Building Height in feet for parcel.*

*17. Front Parcel Setback in feet for parcel. This is the distance from the front facade of the building to the front property line. It is a measure of building intensity. It is a typical measure in zoning regulations.*

*18. Front Curb Setback in feet, with the setback of each building from the curb averaged by building over a block. This is a rough measure of the experience of the setback as it includes the sidewalk and planting strip area (boulevards in Twin Cities terminology).*

*19. Side to side distance between buildings, measured in feet and averaged across a block. This is another rough measure of building bulk.*

*20. Back to back distance between buildings, measured in feet and averaged across a block.*

### Other measures

There are a number of other potential measures of density, and even more of perceived density. For example, the proportion of detached or single family homes in relation to other housing types will affect the perception of density, even though this proportion is calculated on a base of housing units and not land areas. Similarly, measures of crowding are typically based on

people per room. This paper is meant to provide a starting place for examining measures of density and building intensity from their physical base and to clearly distinguish these from separate but related measures of housing mix, crowding, or social and economic characteristics.

### Density and Intensity Measure Summary

- \* Relatively difficult to calculate due to exclusions
- \*\* Easily calculated from field observations and measurements from aerial photos supplemented with web-accessible census data
- \*\*\* Easily calculated using GIS parcel level database, including assessors data and/or census data and TIGER line files

1. Parcel Density \*\*\*
2. Block Density\*\*
3. Part Block Density (parcel approximation)\*\*
4. Net Neighborhood Residential Dwelling/Population Density \*\*\*
5. Net Neighborhood Residential Building Type Density\*\*\*
6. Net Neighborhood Density\*
7. Gross Neighborhood Density\*\*
8. City Density\*\*\*
9. Metropolitan Density (MD)\*\*\*
10. Residential Density at City or Metropolitan Scale\*\*\*
11. Floor Area Ratio\*\*\*
12. Building Site Coverage\*\*\*
13. Building Block Coverage\*\*
14. Impervious Surface Parcel Coverage\*\*\*
15. Impervious Surface Block Coverage\*\*
16. Building Height\*\*
17. Front Parcel Setback\*\*\*
18. Front Curb Setback\*\*
19. Side to side distance\*\*\*
20. Back to back distance\*\*\*

## Fine Print Facts

Some of the most talked about density definitions of the 1990s were the density thresholds for designation as priority funding areas (PFAs) under the State of Maryland's smart growth regulations. Under these regulations, the state would place infrastructure only in areas that reached certain densities. Specifically, they had to be planned for 2.0 units per net residential acre (excluding public recreation, habitat, wetlands, and public open space) in existing areas with sewer or water. For greenfield or peripheral sites, this is raised to 3.5 units per net acre excluding those same public uses (Maryland Office of Planning 1997).

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