

NET DENSITY CALCULATOR

When the Land Use Plan was adopted by the City of Central, staff review of subdivision requests included references to the proposed land uses reflected in the plan. Property owners and developers likewise began to reference the Land Use Plan in establishing the sale value of property and the projected return on development costs based upon the residential densities outlined on the plan. This was a positive outcome.

However, it soon became clear that misinterpretations were occurring due to the fact that owners and developers were basing their calculations on the gross density yield of a parcel. That is - a ten acre property in a low density area were assuming a yield of 20 lots/units (10 acres x 2 units/acre = 20 units). The intent of the Land Use Plan was not to indicate gross densities but to establish areas, based upon surrounding development character and infrastructure, that would yield a net density of 2 units per acre. That is - of the twenty acre parcel that is developed as residential lots, the density goal is two units per acre. This is roughly analogous with the desired half acre lot size identified in the planning process as acceptable for low density residential.

The plan also suggests that public open space be conserved for the benefit of the community, and that one way to accomplish this is to offer “density bonuses” for setting aside undeveloped open areas and adding quality amenities. Such set asides also starting appearing in subdivision requests. However, in the absence of clear guidelines differences of opinion between city staff and developers led to additional confusion about what constituted open space and how the balance between open space/amenities and additional density could be equitably achieved.

These experiences led to the development of a tool that could be used by review staff and developers/property owners to calculate the actual potential yield of a property within the context of conserving open space and optimizing development potential. The Net Density Calculator (NDC) is a “live” Microsoft Excel document that makes automatic calculations of lot size and yield based upon the input provided in certain cells. The automatic calculations are based on some assumptions that are flexible. As such, the tool should be used as a starting place to determine acceptability of a proposal and should not be considered absolute. A description of the tool, its use and the assumptions are illustrated on the following pages.

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As shown in the figure, the NDC has several different kinds of cells that, when values are added, yield a variety of calculations that will help to more accurately present estimated development potential of a property.

The key at bottom left identifies four different kinds of cells in the tool. Only the cells bordered in blue are available for input. The rest of the cells are locked with imbedded formulas. Most of the large cells near the top have a small red triangle. This indicates additional information about the column is available by clicking the triangle. Most of these explanations are descriptions of assumptions which will be explained under the subtitle “Assumptions”. Finally, the Unit Size column has a conditional formatting function. If the values added into the cells causes the lot size to drop below an established minimum, the cell will turn red indicating that adjustments will have to be made (more on this under the “Unit Size” subtitle).

R1 Single Family Project -

NET DENSITY CALCULATION							DENSITY BONUS CALCULATION							TOTAL UNITS		UNIT SIZE				
Acres	Acres	Acres	0.17	0.1	Calculation	2	Acres	Acres	Acres	EQUALS	Units	Units	Units	Units	Units	Acres (minimum .349 ac.)	Sq. Ft.	Approx Lot Width (per code 125 ft)	Approx Lot Depth (per code 124 ft)	Keep between .7 and .5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!	#DIV/0!	125.0	#DIV/0!	#DIV/0!
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!	#DIV/0!	125.0	#DIV/0!	#DIV/0!
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!	#DIV/0!	125.0	#DIV/0!	#DIV/0!
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!	#DIV/0!	125.0	#DIV/0!	#DIV/0!
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!	#DIV/0!	125.0	#DIV/0!	#DIV/0!

KEY

- Enter factual (or estimated) data in these cells
- These auto-calculation cells cannot be altered
- Click on these cells for explanation and information
- This color indicates that lot size is below the minimum acceptable

The calculations spreadsheet is divided into four major headings across the top. They include:

- A Net Density Calculation - which determines the number of units allowed for the developable portions of the property based upon the desired density indicated on the Land Use Plan;
- B Density Bonus Calculation - which provides options for adding density based upon amount and content of conserved open space;
- C Total Units - calculation of the total yield in number of units for the Net Density + the Density Bonus; and
- D Unit Size - calculation of the average size of the lots needed to provide the yield, for which there is a minimum upset that varies by classification.



UTILIZING the NET DENSITY CALCULATOR (NDC)

1. The first step in utilizing the NDC is selecting the right tool. There are currently four versions available for calculating R1, R2, R3 Single Family, and R3 Duplex net densities. Each has formulas and assumptions developed specifically for those land use classifications.
2. Next, the user would enter the gross acreage of the parcel being considered in the top left cell, and the total acres (if any) of wetlands in the cell to the right, and the total acreage of any detention pond areas that would be required to satisfy floodplain management regulations. This number may be estimated if unknown in the early design stages, but should be revised when established. Since these three values are constants, notice that the rest of the cells below them are automatically filled. Initial calculations for Estimated Infrastructure ROW and Minimum Required Open Space are auto-calculated based upon the gross acreage. (See image detail below) For the purpose of demonstration, we use an example of a fifty acre parcel in the R2 (medium density residential classification) the has five acres of wetlands and an estimated detention pond area of three acres.

R2 Single Family Project - EXAMPLE

NET DENSITY CALCULATION								
Acres	Acres	Acres	0.2	0.1	Calculation	4		
Gross Acreage of Parcel	Wetlands (acres)	Detention Pond Area	Estimated Infrastructure R.O.W. (20%)	Minimum Required Open Space (10%)	Remaining Acreage	Desired Net Density (Units Per Acre)		
50.0	5.0	3.0	9.4	4.5	28.1	112.4	4.5	0.0
50.0	5.0	3.0	9.4	4.5	28.1	112.4	4.5	0.0
50.0	5.0	3.0	9.4	4.5	28.1	112.4	4.5	0.0
50.0	5.0	3.0	9.4	4.5	28.1	112.4	2.5	


3. Note that the estimated area for infrastructure is calculated as 9.4 acres and that the minimum required open space is calculated as 4.5 acres, which leaves a total of 28.1 developable acres with a desired net density of 112.4 units. The developable area of the property - 28 acres- yields 112 units, or 4 units per acre which is the target density for Medium Density Residential from the Land Use Plan.
4. A preliminary development plan could be drawn up using these figures with high confidence that it would meet development requirements in the City

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of Central. However the NDC tool offers additional functions that may help optimize both open space conserved as well as the number of units yield.

- Under the Density Bonus Calculation section of the tool inputs can be manipulated to explore various combinations and their impact on yield. The first cell allows for input of the total acres of qualified open space. If this number is equal to the required 10%, no bonus is calculated as shown in the top row of the figure below. In that case the number of unit yield (112.4) is unchanged. However as shown on subsequent rows in the figure, if additional



DENSITY BONUS CALCULATION							TOTAL UNITS
Acres	Acres	Acres	EQUALS	Units	Units	Units	Units
Total Qualified Open Space (non-forested)	Qualified Open Space Over 10%	Conserved Forested Open Space	Net Acreage for Units	Open Space Bonus	Forest Conservation Bonus	Bonus Units	Total Units
4.5	0.0	0.0	28.1	0.0	0.0	0.0	112.4
4.5	0.0	2.5	25.6	0.0	6.7	6.7	119.1
4.5	0.0	2.0	26.1	0.0	5.3	5.3	117.7
2.5	-2.0	9.5	20.6	-4.0	25.3	21.3	133.7



acreage is conserved, either as qualified open space or as conserved forested open space, some significant bonuses can be accrued. Notice that in the last row where a total of 12 acres of open space are conserved (9.5 of which are forested), the scheme would merit an additional 21 units. This is due to the fact that the highest bonus values come from preserving existing forested areas as open space. The same 12 acres conserved in the qualified open space column with no forested acres would only yield 15 additional units instead of the 21 units shown here.

- The final segment of the NDC , the Unit Size segment, calculates the average size of the individual units based upon the total number of developable acres divided by the total number of units number of units accrued after the calculation of density bonuses. This calculation assumes that all units are of equal size - which is not required- and as such gives a general guideline. As mentioned earlier, each classification has a minimum size allowable. A scheme that results in lot sizes smaller than the acceptable minimum are not considered viable.
- In the R2 development example, where desired net density is 4 units per acre,



the starting point is .25 acres per lot which is the requirement stipulated in the City’s revised zoning ordinance. The minimum upset size for lots in R2 is .149 acres, or 60% of the .25 acre desired size. As shown on the figure below, this minimum size is almost reached by the final calculation - the one that yielded the maximum number of units. If the figures used in the density bonus calculation had pushed the total number of units to a point where this minimum was exceeded, the unit size cell would have turned red indicating an unacceptable unit size in the R2 classification. The cells to the right simply give

		TOTAL UNITS	UNIT SIZE				
Units	Units	Units	UNIT SIZE	UNIT SIZE			
Forest Conservation Bonus	Bonus Units	Total Units	Acres (minimum .149 ac.)	Sq. Ft.	Approx Lot Width (per code 75 ft)	Approx Lot Depth (per code 140 ft)	Keep between .7 and .5
0.0	0.0	112.4	0.25	10890.0	80.0	136.1	0.588
6.7	6.7	119.1	0.22	9365.6	80.0	117.1	0.683
5.3	5.3	117.7	0.22	9656.7	80.0	120.7	0.663
25.3	21.3	133.7	0.15	6709.9	68.0	98.7	0.689



some guidance for determining lot dimensions. These are not requirements, but suggested variances that would be considered acceptable.

ASSUMPTIONS

As mentioned earlier, the NDC tool is populated with formulas based on assumptions that have been tested in the planning process and found to be in conformance with the City of Central’s development goals. At this time, they are recommendations and would benefit from further refinement. The current assumptions are as follows:

1. Wetlands - jurisdictional wetlands are considered undevelopable and thus are subtracted from the total parcel size before density calculations are made. If they are to remain undisturbed, they may qualify as conserved open space eligible for density bonuses if they meet open space criteria.
2. Detention Pond - are likewise not considered developable land, and due to the fact they may be frequently inundated do not qualify for open space consideration.

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3. Estimated Infrastructure - in most residential developments a significant amount of acreage is used in the provision of roadways, sidewalks and other ROW development. This acreage is required for the proper functioning of all developments and cannot be used for the division of land into lots for development units. It is, therefore, subtracted before the density calculations are made. The amount of land needed for infrastructure varies based on the shape of the property, the width of streets and a number of other factors. For the purpose of the calculation a percentage of the developable parcel is subtracted before density calculations are made. The percentages vary based on the classification and are conservative estimates that should be re-calculated if actual figures are available.
4. Minimum Required Open Space - mandated by the Planned Unit Development code at 10%. The tool calculates 10% the gross acreage of the parcel less the acreage in wetlands and established the minimum required open space for conservation.
5. Remaining Acreage - is considered the developable area of the parcel and is calculated by subtracting the wetlands, detention pond, infrastructure and required open space from the gross acreage.
6. Desired Net Density - is based on the underlying land use classification and is calculated by multiplying the remaining acreage by the desired net density.
7. Total Qualified Open Space - for which standards are not completely settled, does not include wetlands, detention areas, infrastructure R.O.W nor open space that is considered incidental or disconnected from the overall development scheme. Qualified open spaces cannot be, for example, separate remnants of property on the edges of the overall parcel being developed. They should be consolidated within the design scheme to provide the maximum of connectivity and community value by providing access to trails, nice views or developed park spaces. Length and width ratios should be carefully evaluated with an effort to avoid long and narrow strips inadequate for comfortable development as walking trails or buffer areas. Detention areas and wetlands may be incorporated into open space but must serve some aesthetic or functional purpose that provides an amenity to the overall community not only the neighborhood being developed. (See Appendix DG-3 for additional guidance on Open Space Standards).
8. Conserved Forested Open Space - this column is intended to add emphasis to preserving one of the City's greatest assets - its many forested areas.



Maximum density bonus is given to forested areas voluntarily undisturbed in the development process. The guidelines for this category also needs further refinement. Definitions of what constitutes a forested area needs to be developed based upon size of trees, number of trees per acre, maturity of tree stands, and special scenic properties or cultural significance. Special protection of these areas during the construction process should also be developed and adopted to ensure survival over the long term.

9. Open Space Bonus - the open space bonus - that is bonus density for open space above and beyond the required - is calculated by multiplying the qualified open space above and beyond the required 10% by the desired net density and dividing by two. That is, for every additional acre of qualified open space, the bonus equals half a unit.
10. Forest Conservation Bonus - this bonus is more generous due to the high value of mature forested areas in the city. The calculation is made by multiplying the conserved forested open space by the desired net density and dividing by 1.5. That is for every two acres of conserved forested open space, the bonus equals two units.
11. Minimum Unit (Lot) Size - it is recommended that lots not be allowed that are less than 60% of the desired lot size as specified in the City's zoning ordinance . The purpose of this limit is to provide, as much as is possible, continuity of lot size between existing and new developments, while also providing incentives for developers to conserve open space and provide high quality development designs that add value to the City.

In conclusion, the Net Density Calculator tool has provided some very important guidance for future developments in the city. Some adjustments will be needed and clarifications and definitions will need to be adopted to support the optimum utilization and refinement.

A printed version the calculators for the various classifications are included in Annex DG-2.