

Metropolitan Council's Annual Population Estimates Methodology

Metropolitan Council prepares local population estimates for the Twin Cities seven-county area. These estimates are the official population and household estimates for State government purposes. Metropolitan Council has the statutory responsibility to develop the estimates, distribute them for local government review, receive comments or challenges, revise estimates as warranted, and certify final estimates (Minnesota Statutes 473.24).

Since the 1970s, Metropolitan Council has used a housing-stock-based estimation model. In 2005-06, Metropolitan Council Research conducted a review and redesign of the Council's methodology and process. Minnesota Population Center demographers at University of Minnesota advised and collaborated. The model resulting from the 2005-06 redesign remains a housing-stock-based model and allows multi-year review of housing gains and losses.

In reduced form, the Council's model determines housing units, households and population as follows:

$$\text{Housing Units}_{2008} = \text{Housing Units}_{2000} + \Sigma(\text{Housing Changes}_{2000 \text{ to } 2007})$$

$$\text{Households}_{2008} = \text{Housing Units}_{2008} \times \text{Occupancy Rates}$$

$$\text{Total Population}_{2008} = (\text{Households}_{2008} \times \text{Persons Per Household}) + \text{Group Quarters Pop}_{2008}$$

Methodology improvements.

Over the past four years, Council staff have worked to continue the improvement of the Annual Estimates methodology.

- With the 2006-07 estimates cycle¹, the Council began using new USPS address vacancy data and Census American Community Survey (ACS) data to adjust housing occupancy rates and household size multipliers. These improvements allow a more realistic, real-time representation of population growth since 2000.
- In 2007-08, the Council revised the algorithm for household size multipliers to reflect the observed phenomenon of newly-built houses attracting housing consumers (households) with a larger average household size.
- With the 2008-09 estimates cycle, the Council revised assumptions of completion rates (from building permit to completion) for multi-family housing (apartments and condominiums).
- Also new in 2008-09, the Council has revised the algorithm for estimating tenure (renting vs. owning) of newly-built attached housing and multi-family housing. The new programming uses data that local governments report to the Council in the Affordable Housing Production survey (formerly known as the Livable Communities Act survey). The net effect will be a more accurate estimation of owner-occupied and rental housing stock subtotals. At the same time, the Council

¹ Previous-year estimates are prepared the following year and certified by July 15. For example, population as of April 1, 2008, is estimated in Spring 2009 and certified by July 15, 2009. This timeline is specified in Minnesota Statutes 473.24.

is reducing its use of homestead counts in estimation; homestead counts will be used only as a quality check on modeled ownership subtotals.

Estimation of housing stock.

For the April 1, 2008, estimates, the Council works to estimate housing unit counts, segmented by housing type:

- Single-family detached houses
- Townhomes and other single-family attached
- Units in duplexes and 3- and 4-unit buildings
- Units in multi-family buildings (5 or more units, condos or apartments)
- Manufactured homes

Revised 100% count statistics² provide the year 2000 base for the four categories of *built* housing stock. The Council's model adds on housing stock changes since 2000. These include:

- Housing units permitted³ – see below
- Other gross additions to housing stock – see page 3
- Gross losses to housing stock (a debit) – see page 3

Apart from built housing stock, many cities and towns have manufactured homes. Manufactured homes are fully recounted each year. (See page 4.)

Housing units permitted. Council Research collects data on housing units permitted through an annual survey of cities and towns. Where cities or towns do not participate, Council Research may substitute data from the US Commerce Department's Building Permits Survey. The substitute data are comparable but not always complete.⁴

The Council's model assumes that not all housing units permitted will be built in the year permitted. In crediting the most recent year of permitting, the Council assumes:

- 85% completion for multi-family developments (5 or more units)
- 90% for townhomes, duplexes, 3- and 4-unit buildings
- 95% for single family detached

These multipliers are suggested by cycle-time (permit to start to completion) distributions from the US Commerce Department's Survey of Construction (SOC). Single-family detached are the most likely to be completed in the same year permitted; multi-family construction has the longest cycle-times.

² Census 2000, SF3, table H3 and table of "Corrected Counts" provide the total numbers of units in each minor civil division. Table H30 provides the housing type distribution within those totals.

³ The Council assumes that housing units permitted in 2000 would *not* be completed and readied for occupancy until 1st Quarter 2001; and that housing units permitted in 2007 would *not* be completed and readied for occupancy until 1st Quarter 2008.

⁴ The Council has found, in a number of instances, that cities and towns under-report to US Commerce Department. The data are online at <http://socds.huduser.org/permits/>

Most of the units “held back” will be completed and readied for occupancy after April 1 of the year following permitting, and will be counted in subsequent years’ estimates. Over the long-term, Council Research assumes 100% eventual completion for most types of built housing; and 92.5% eventual completion for multi-family buildings (5 or more units).

During years 1999-2004, across a national sample of cities, the Census Bureau’s Survey of Construction (SOC) documented an 85% permit-to-start-to-completion rate in multi-family, mostly due to design changes, misclassification, and units not started, as well as starts abandoned.⁵ Metropolitan Council staff determined, based on Twin Cities market experience, that eventual Twin Cities completion rates are better than the national average. The Council’s model assumes 92.5% eventual completion for multi-family buildings (5 or more units).

Gross additions and gross losses. Gross additions include moved-in housing units and conversions reported to the Council’s annual survey, as well as units annexed in and reported to Minnesota State Demographer’s survey.⁶

Gross losses include moved-out units and demolitions reported to the Council’s annual survey, as well as units annexed out and reported to Minnesota State Demographer’s survey.

Other adjustments. Beyond this, Council Research is able to make other needed, but date-uncertain adjustments to housing stock. There are three situations where Council Research has done this:

- Evidence of housing units missed by Census 2000 or missed by local building permits record-keeping may warrant an upward adjustment to housing unit counts. Such evidence might include a municipal housing stock enumeration or administrative records analysis.
- Comparison of estimated total housing vs. homestead counts (owned and occupied)⁷ may also necessitate an upward adjustment.
- Evidence of unreported demolitions may warrant a downward adjustment.

Housing stock calculation. As an example, for Single-Family Detached (SFD) housing stock, the calculation can be specified:

$$\text{SFD}_{2008} = \text{SFD}_{2000} + (\text{SFD Permit}_{2000 \text{ thru } 2006}) + (\text{SFD Permit}_{2007} \times 95\% \text{ Completion}) + (\text{SFD Additions}_{2000 \text{ thru } 2007}) + (\text{SFD Loss}_{2000 \text{ thru } 2007}) + \text{SFD Other Adjustments}$$

Where:

- SFD_{2000} = 2000 housing units
- SFD Permit = Number of units permitted since 2000
- SFD Additions = Other gross additions since 2000
- SFD Loss = Gross losses since 2000
- Completion rate assumes that not all permitted units from previous year will be completed by April 1 of estimates year.

⁵ US Census Bureau, “Relationship Between Building Permits, Housing Starts, and Housing Completions,” online at www.census.gov/const/www/nrcdatarelationships.html

⁶ The State Demographer’s survey is authorized by Minnesota Statutes 4A.02, paragraph (b)(10).

⁷ Homestead counts come from Minnesota Department of Revenue’s Abstract of Assessments database.

The calculation of Townhomes, Duplex/Triplex/Quads, and Multi-family housing stock use the same formula specification—but with housing type-specific completion rate assumptions, discussed above.

Ownership and rental housing segmentation and re-balancing. Council Research accounts housing stock estimates, segmented by housing type, as described above.

These estimates of housing stock are multiplied by estimated ownership rates. For older housing (pre-2000), ownership shares are determined from Census 2000 statistics.⁸ For new (2000 and after) attached and multi-family housing, the model uses the Council’s Affordable Housing Production Survey data to determine owner and renter shares. (The model assumes all new Single Family Detached houses will be ownership housing.) The resulting products, by housing type, are summed to determine an ownership housing subtotal, and a rental housing subtotal.

Following this, the estimated housing segmentation is re-balanced: The “first cut” ownership subtotal is quality checked against Minnesota Department of Revenue’s homestead units counts. Homestead units are, by definition, owner-occupied housing, and so are used in the model as a minimum expectation for the modeled ownership subtotal. If necessary, some rental units can be “re-cast” from estimated rental housing into ownership housing.

Housing units outside of built housing stock. In addition to the built housing stock, Council Research also estimates manufactured home units. Manufactured homes in manufactured home parks are enumerated through a survey of park operators/managers. Manufactured homes outside of parks are counted through Council Research’s annual survey of cities and towns.

Council Research does not attempt to estimate the number of boats or RVs serving as “housing units.” The number of boats and RVs serving as “housing units” is impossible to estimate without direct enumeration. The Council takes the Census 2000 estimate of such units and retains those numbers as a placeholder.

Estimation of households.

Following the completion of housing stock estimation, the Council model applies occupancy rates to minor-civil-division-level housing units, segmented by housing type. The number of households is equivalent (in definition) to non-institutional occupied housing units. It is calculated as the sum of:

- Single family detached units *multiplied by* occupancy rate
- Townhome units *multiplied by* occupancy rate
- Duplex, triplex, quads units *multiplied by* occupancy rate
- Owned multi-family (condo) units *multiplied by* occupancy rate
- Rental multi-family (apartment) units *multiplied by* occupancy rate
- Manufactured homes *multiplied by* occupancy rate
- Boats and RVs serving as “housing units” according to Census 2000 *multiplied by* 100%.

⁸ Each minor civil division’s number of owner-occupied units (found in Census 2000, SF3, table H32) is divided by total occupied units (determined from SF3, tables H32 and H33).

Occupancy rates. The Council's model is programmed to calculate and apply six occupancy rates:

- Single family detached occupancy
- Townhomes occupancy
- Duplexes, triplexes, and quads occupancy
- Owned multi-family units (condos) occupancy
- Rented multi-family units (apartments) occupancy
- Manufactured homes occupancy

The first four occupancy rates listed are composite measures, designed to represent the variation of occupancy rates by housing type and by local area:

- USPS address occupancy rates⁹ for a local area (but without housing type segmentation) are given 50% weight.
- Adjusted Census occupancy rates for specific housing types are also given 50% weight.

The adjusted Census occupancy rate takes Census 2000 occupancy rates (locally-specific and housing type-specific)¹⁰ and deflates (or inflates) for regional average change since 2000. The adjustment comes from a region-level comparison of Census 2000 occupancy rates vs. more recent Census data on occupancy rates. As an example, Single-Family Detached (SFD) occupancy rates are specified:

$$\begin{aligned} \text{SFD Occ Rate}_{\text{Local}, 2008} = & \\ & 50\% \times \left(\text{Addresses occupied}_{\text{Local}, 2008} / \text{All addresses}_{\text{Local}, 2008} \right) \\ & + 50\% \times \left(\text{SFD Occ Rate}_{\text{Local}, 2000} \times \text{SFD Occ Rate}_{\text{Region}, 2007} / \text{SFD Occ Rate}_{\text{Region}, 2000} \right) \end{aligned}$$

At region-level, Council Research's analysis of Census data finds that occupancy rates have *declined* across housing types. The declining occupancy rates are not a surprise: The market has re-balanced after extremely low vacancy rates in year 2000. The formula applied in the Council's estimation model accomplishes an across-the-board deflation of occupancy rates.¹¹

For rented multi-family units (apartments), occupancy rates from GVA Marquette's March survey of apartment properties are substituted into the Council's estimation model, where available. The GVA Marquette survey covers 73 communities with substantial numbers of rental apartments (over 250 apartment units). For other communities, with less consequential numbers of rental apartments, the Council's model again applies the composite rate discussed above: USPS address occupancy rates and adjusted Census occupancy rates.

⁹ USPS address occupancy rates are calculated from USPS route administrative data, summarized by Census tract, available online at www.huduser.org/datasets/usps.html

¹⁰ Each minor civil division's number of vacant units (found in Census 2000, SF3, table H31) is divided by total units (found in SF3, table H30).

¹¹ Council staff have considered local-level American Community Survey data in place of Census 2000 data. Starting with the 2011-12 annual estimates cycle, the Council will replace Census 2000 local vacancy rates data with ACS 5-Year Average vacancy rates data. More information on the American Community Survey can be found online at www.metrocouncil.org/Census/acs.htm

Finally, for manufactured homes, local occupancy is taken directly from Metropolitan Council's annual survey of manufactured home parks. The survey counts total manufactured homes and occupied manufactured homes.

Population in group quarters.

Metropolitan Council Research enumerates known group quarters in order to account persons living in institutional or non-household settings. The list is refreshed annually to include licensed group homes known to the Minnesota Department of Human Services (DHS). Small group homes (less than 10 beds) are assumed to be occupied at the capacity identified by DHS. Other types of group quarters, as well as medium and larger group homes (at least 10 beds) are surveyed annually.

Since the Council's survey is conducted annually, the resulting counts fully replace the counts from previous years or from Census 2000.¹²

Estimation of population in households.

The final step in the Council's model is calculation of population in households. To accomplish the calculation, households estimates are segmented by housing type and tenure; and household size multipliers are applied. Council Research favors this approach because changes in housing units by type can be reliably estimated, as described in previous sections of this paper.

Household size change. Average household sizes in a community adjust over time. This necessitates modification of the household size multipliers from Census 2000.

Council Research has studied the shifts using public use microdata (PUMS) from 2005-07 American Community Surveys and from Census 2000. At the region-level, average households sizes generally declined for Owner-Occupied Single Family Detached housing. There is an exception to the decline trend: Owner-occupied households in newly built (since 2000) Single Family Detached units have larger numbers of people in the household.

The household size multipliers used in the Council's annual estimation model start with Census 2000 person per household multipliers, for each community, segmented by housing type and tenure, but then adds (or subtracts) a change adjustment.

At region-level, cross-section analysis of Census data finds:

- Average household size for Rented Single Family Detached housing increased to 3.18 persons per household (PPH); +0.10 persons per household is added to local Census 2000 PPH multipliers for this housing type.
- Average household size for Rented Duplex/Triplex/Quad units is 2.41 PPH; for Rented Townhomes, 2.82 PPH; and for Rented Multi-family (apartments), 1.72 PPH; these multipliers are unchanged from Census 2000.

¹² If a survey for a facility is not returned and field follow-up does not result in participation, Council Research carries over the group quarters population from the previous annual survey.

- Average household size for Owner-Occupied Townhomes is 1.89 PPH; this multiplier is unchanged from Census 2000.
- Average household size for Owner-Occupied Duplex/Triplex/Quad units declined to 1.99 PPH; accordingly -0.10 persons per household is debited from local Census 2000 PPH multipliers for this housing type.
- Average household size for Owner-Occupied Single Family Detached housing declined to 2.83 PPH; -0.08 persons per household is debited from local PPH multipliers for this housing type.
- Average household size for Owner-Occupied Single Family Detached housing built *since* 2000 is higher: 3.43 PPH. To represent this, local PPH multipliers are increased by a variable amount where recent housing production substantially outpaces the historical production.¹³
- Average household size for Owner-Occupied Multi-family (condominiums) is 1.40 PPH; this multiplier is unchanged from Census 2000.
- Average household size for Owner-Occupied Multi-family (condominiums) built *since* 2000 is higher: 1.60 PPH. To represent this, local PPH multipliers are increased by a variable amount where recent housing production substantially outpaces the historical production.¹⁴

At the region-level, average household sizes related to housing age were evaluated for all housing and tenure combinations. The cross-section analysis found average household sizes of: 3.43 in newly built Owner-Occupied Single Family Detached housing; 2.83 overall in Owner-Occupied Single Family Detached housing. Recognizing this significant, stock-related difference, the community-level adjustment of average household size for this housing type will be variable with the “newness” of Single Family Detached housing stock. The average household size may be credited upward, by a variable amount, if recent production of Single Family Detached Housing in a community outpaces the historical production.

A difference was also found in Owner-Occupied Multi-family housing (condominiums): Average household size was 1.60 in newly built units; 1.40 overall in Owner-Occupied Multi-family. So, PPH multipliers for this housing type may be increased by a variable amount where recent housing production outpaces the historical production.

For other housing segments, cross-section differences related to age of housing were either not statistically significant or not estimable due to sample sizes.

It may be viable in the future to use *local-level* American Community Survey data in place of the household size calculations described above. This is an anticipated enhancement for the 2009-10 annual estimates cycle.

¹³ The shift for Single Family Detached housing is calculated through comparison: Years 1992-99 production of housing is subtracted from 2000-07 production in a given community. The difference, representing a shift in “newness” of housing stock, is then divided (normalized) by the total Single Family Detached housing stock. The resulting variable ranges from 0 to 67% (an instance where 69% of homes were built in the current decade, 2% in the previous decade). This resulting variable was multiplied by +0.60 persons per household, representing an improvement in average household size due to the amount of new Owner-Occupied Single Family Detached housing.

¹⁴ Years 1992-99 production of Multi-family housing is subtracted from 2000-07 production in a given community. The difference, representing a shift in “newness” of housing stock, is then divided (normalized) by the total Multi-family housing stock in the community. The resulting variable, ranging from 0 to 100%, was multiplied by +0.20 persons per household, representing an improvement in average household size due to the amount of new Owner-Occupied Multi-family housing.

Population in households calculated. Estimates of households, segmented by housing type and by tenure (owner or renter), are multiplied by type-and-tenure-specific persons per household (PPH) multipliers. The product is the population in households:

$$\text{Population in Households} = \sum_{\text{housing types, tenure}} (\text{Households}_{\text{h.t., tenure}} \times \text{PPH}_{\text{h.t., tenure}})$$

Total population.

Total population requires one additional term -- group quarters population enumerated annually by the Metropolitan Council:

$$\text{Total Population} = \sum_{\text{housing types, tenure}} (\text{Households}_{\text{h.t., tenure}} \times \text{PPH}_{\text{h.t., tenure}}) + \text{Group Quarters Pop}$$

Maintenance of the model.

The Council's model is maintained as a Microsoft Access database. When input tables are loaded, subsequent calculations and compilations are performed as a series of Microsoft Access queries.

Input tables include minor-civil-division-level data on:

- Permitted housing units, segmented by housing type
- Other gross changes, segmented by housing type
- Homestead counts
- Ownership and rental units counts for new housing built since 2000
- Rental apartment vacancy rates
- Manufactured home counts
- Census 2000 revised 100% count statistics on housing, segmented by housing type
- Census 2000 housing units, segmented by housing type and tenure
- Census 2000 persons-per-household multipliers
- United States Postal Service (USPS) data on address occupancies and vacancies

The US Census Bureau's long range plan is to provide continuous collection and release of local demographic and housing data through the American Community Survey. The first data for the Twin Cities region, based on 2.5% annual sampling of all households and a 68% response rate, were released in 2006, 2007 and 2008.

The Council's model is designed to allow annual adjustment of local assumptions – specifically occupancy rates, and persons-per-household multipliers – with regional analysis of American Community Survey data used to calculate adjustment factors. Starting with the 2011-12 annual estimates cycle, the Council will replace Census 2000 local data with ACS 5-Year Average data and decennial Census 2010 counts.¹⁵

¹⁵ More information on the American Community Survey can be found online at www.metrocouncil.org/Census/acs.htm