ANNUAL POPULATION ESTIMATES METHODOLOGY

Revised May 2024

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The Metropolitan Council prepares local households and population estimates for the Twin Cities seven-county area. The 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. These estimates are the official household and population estimates for State government purposes (*Minnesota Statutes* 473.24).

Since the 1970s, the Metropolitan Council has used a housing stock-based model to estimate households and population. While it is difficult to estimate the three components of population change (birth, death, and migration) at the local level, it is much easier to know how many housing units there are. We can then use what we know about those units to estimate how many people live in them.

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

Housing Units$_{2023}$ = Housing Units$_{2020}$ + Σ(Housing Changes$_{2020\text{-}2023}$)

Households$_{2023}$ = Housing Units$_{2023}$ X Occupancy Rates

Total Population$_{2023}$ = (Households$_{2023}$ X Persons Per Household) + Group Quarters Pop$_{2023}$

The population grows when:

- More housing units are added (measured by building permits); and/or
- More of those housing units are occupied by households (measured by occupancy/vacancy rates); and/or
- Those households have more people (measured by average household size).

Methodology improvements
Over the past two decades, we have worked to continually improve our annual estimates methodology.

- With the 2011-12 cycle, Census 2000 occupancy rates and household size multipliers were fully replaced with the most recent American Community Survey (ACS) five-year rates and multipliers. These rates and multipliers are calibrated to reconcile population estimates with Census 2010 counts and other data resources.
- With the 2015-16 cycle, we began using multiple data resources to estimate occupancy rates and average household size multipliers. The "weight" given to each data resource is locally customized and depends on the suitability and statistical reliability of each data resource for each city.
- Starting with the 2021-22 cycle, housing stock estimates and lists of group quarters facilities have been refreshed along with occupancy rates and household multipliers. Additionally, we began starting with estimates for counties (for which more reliable data is available) and ensuring that city/township estimates align with county totals.

Estimation of housing stock

For the April 1, 2023 estimates, we have worked to estimate housing unit counts, segmented by type. Housing types are:

- Single-family detached houses
- Townhomes (single-family attached)
- Units in duplexes and 3- and 4-unit buildings
- Units in multi-family buildings (5 or more units, including both condominiums and apartments)
- Accessory dwelling units (ADUs, small housing units on the same lot as a single-family home)
- Manufactured homes
- Other shelters (boats, RVs, and other situations that would not normally be considered)

For the first five housing types, the Council's model starts with base year (2020) housing stock, then adds (or subtracts) housing stock changes since 2020. These include:

- Housing units permitted
- Other gross additions to housing stock, such as conversions from commercial uses
- Gross losses to housing stock, such as demolitions

Base year housing stock

The base year (2020) housing stock is controlled to the Census 2020 count of all housing units.[1]

Base year housing stock *by type* is calculated by multiplication of the count with percentage shares representing each housing type. Because the 2020 Census did not gather data on housing type, these percentage shares needed to be estimated. See Appendix A for more information.

These estimates may not align perfectly with other data sources. One reason for this is the need for consistency with the 2020 Census, which provides the baseline data for our estimates. If the 2020 Census counted too few or too many housing units, these estimates will be off as well. Another reason is how local governments report building permits to us. We attempt to standardize the definitions of housing types used in building permit reports, and we attempt to reconcile the numbers of units reported with other data sources. Still, our estimates ultimately depend on the accuracy of the data local governments submit to us, and we are grateful for their efforts.

Discrepancies in total numbers of housing units are possible. Evaluating the estimates model process used prior to 2020, there were 23 communities (out of 186) with housing counts differing from the Census 2020 enumeration by at least 100 units.[2] In 10 of these cases, the Council previously overestimated housing counts; this was likely due to an assumption that all permitted units are eventually completed. In the other 13 cases, the Council previously underestimated housing counts, likely due to incompleteness of building permit record-keeping or reporting by local governments. The

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[1] We have corrected an issue that erroneously placed several hundred housing units in Dahlgren Township in the City of Carver. We have also made a small number of much more minor edits. These decisions are detailed here: *https://metrocouncil.org/Data-and-Maps/Research-and-Data/Census-Data/How-we-edited-initial-2020-Census-Data.aspx*

[2] In our 2011 evaluation of our housing unit estimates against the 2010 Census, there were 31 communities where our estimates diverged from the 2010 Census counts by at least 100 units.

Council's method for estimating housing counts relies on the accuracy and completeness of city- and town-provided data inputs.

Housing units permitted

We collect data on housing units permitted through an annual survey of cities and towns. In the rare cases when cities or towns do not respond to the survey, we substitute data from the US Commerce Department's Building Permits Survey. The substitute data are comparable but not always complete.[3]

The Council's model assumes that not all housing units permitted will be built in the year permitted. Single-family detached homes are the most likely to be completed in the same year permitted; multi-family construction has the longest cycle-times. The remaining permitted units are assumed to be completed and occupiable later, and they will be counted in subsequent years. In crediting the most recent year of permitting and construction, the Council assumes:[4]

- 85% same-year completion for townhomes, duplexes, 3- and 4-unit permits; 15% later completion
- 90% same-year completion for single family detached permits; 10% later completion
- Multifamily permits are counted only if they had opened for occupancy by April 1, 2023, as determined by city-issued certificates of occupancy and/or CoStar data.[5] Almost all multifamily units permitted in 2022 had not yet opened by April 1, 2023 and did not count toward the 2023 estimates but will count toward future years' estimates. However, we estimate that there were approximately 17,100 multifamily units regionwide permitted *before* 2020 and open by April 1, 2023 that were not included in the 2020 Census. We have incorporated them into the 2023 estimates.

Gross additions and losses to housing stock

Gross additions include physically moved structures, conversions reported to the Council's annual survey, and units annexed in as determined by the *Municipal Boundary Adjustment unit* in the Office of Administrative Hearings.

Gross losses include physically moved structures and demolitions reported to the Council's annual survey as well as units annexed out.

Housing stock calculated

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

$$\textbf{SFD}_{2023} = \text{SFD}_{2020} + (\text{SFD Permit}_{2020\text{-}2021}) + (\text{SFD Permit}_{2022} \times 90\% \text{ Same-Year-Completion}) +$$

$$(\text{SFD Additions}_{2020\text{-}2022}) + (\text{SFD Losses}_{2020\text{-}2022}) + \text{SFD Other Adjustments}$$

Where:

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[3] We have found that some cities and towns underreport to the US Department of Commerce. The data are online at *http://socds.huduser.org/permits/*

[4] These are region-wide assumptions. Unfortunately, there is not information about where permitted construction failed to occur. Over the long term, we assume 100% eventual completion.

[5] CoStar is a proprietary source of data with more up-to-date information on rental apartments across the region than the ACS provides.

- SFD$_{2020}$ = 2020 housing units
- SFD Permit$_{2020-2021}$ = Number of units permitted in 2020 and 2021
- SFD Permit$_{2022}$ = Number of units permitted in 2022
- SFD Additions$_{2020-2022}$ = Other gross additions in 2020-2022
- SFD Losses$_{2020-2022}$ = Gross losses in 2020-2022
- As described above, the 90% completion rate assumes that not all units permitted in 2022 were completed by April 1, 2023.

The calculations of Townhomes, Duplex/Triplex/Quads, and Multifamily housing stock are comparable – but with different assumptions about same-year completion, as described previously.

Housing units outside of built housing stock
In addition to the built housing stock, we also estimate manufactured home units. Manufactured homes in manufactured housing parks are counted through an annual survey of park operators/managers.

We do not estimate directly the number of other shelters (boats, RVs, and other situations that would not normally be considered). Instead, we take the "other" number from the most recent local ACS five-year estimates, counting such units only if they are occupied.

Estimation of households
Following the completion of housing stock estimation, the Council model applies occupancy rates to those housing units in order to estimate the number of households. (By definition, the number of households is identical to the number of occupied housing units.)

County occupancy rates for each housing type
Because data for large geographic areas is more reliable than data for smaller geographic areas, we start by estimating occupancy rates and households for counties – first for 2020 and then for 2023. (Data specific to housing types is not available in the 2020 Census and requires estimation.) Manufactured housing occupancy rates came from our survey, multifamily occupancy rates came from a blend of CoStar and American Community Survey data, and occupancy rates for other housing types came from the 2015-2019 American Community Survey.[6] These housing type-specific occupancy rates were then adjusted so that they matched the county's overall 2020 Census occupancy rate (regardless of housing type) when applied to the county's housing stock.

To estimate each county's occupancy rate in 2023, we used the same sources as with the 2020 occupancy rates, substituting the most recent American Community Survey data (covering the 2018-2022 period). To adjust the 2018-2022 ACS data so that it better reflects 2023 housing market conditions, we subtracted 0.3 percentage points from ACS single-family detached and townhome occupancy rates and 1.5 percentage points from ACS duplex/triplex/quadplex and multifamily occupancy rates. We also imposed a constraint that a given county's type-specific occupancy rate could change by no more than 3 percentage points (for single-family detached and townhome units) or 6 percentage points for duplex/triplex/quadplex and multifamily units, relative to the type-specific

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[6] We used the 2015-2019 vintage of ACS data because sampling error tended to be considerably smaller than 2016-2020 data. The specific vintage used influences only the *relative* occupancy rates of different housing types; all occupancy rates are adjusted so that the county's *absolute* occupancy rate matches the 2020 Census occupancy rate.

occupancy rate estimated for 2020. This mitigates the rapid swings in ACS data that can come from sampling error rather than actual, on-the-ground change.

Local occupancy rates

Initial calculations of local occupancy rates were the same as the calculations of county occupancy rates, this time using locally specific data. Following this, the local occupancy rates were adjusted so that they yielded the same county-level occupancy rates estimated as described above.

Households calculated

Estimates of housing units, segmented by housing type, are multiplied by housing-type-specific occupancy rate multipliers. The sum of the products is the estimated households:

Households = $\Sigma_{housing\ type}$ (Housing units $_{h.t.}$ X OccRt $_{h.t.,}$)

That is, the estimated number of households for cities and townships is the sum of:

- Single family detached units *multiplied by* occupancy rate
- Townhome units *multiplied by* occupancy rate
- Duplex/triplex/quadplex units *multiplied by* occupancy rate
- Multi-family (apartment) units *multiplied by* occupancy rate
- Accessory dwelling units (ADUs) *multiplied by* occupancy rate
- Manufactured homes *multiplied by* occupancy rate
- Other shelters serving as housing units *multiplied by* 100%.

Estimation of population in households

The final step in the Council's model is calculating the population in households. Household estimates are segmented by housing type, and household size multipliers are applied. We favor this approach because changes in housing units by type are associated with differing household sizes; 100 single-family units accommodate more occupants than the same number of multifamily units.

County average household sizes

As with occupancy rates, we start by estimating the average household sizes of each housing type for counties, first for 2020 and then for 2023. The foundation of the 2020 average household size estimates is the 2015-2019 American Community Survey, except that the manufactured home average household size comes from our survey. These housing type-specific average household sizes are adjusted so that they match the county's overall average household size (regardless of housing type) in the 2020 Census.

For average household sizes in 2023, we start with the 2018-2022 American Community Survey data, lowering each number by 0.02 persons per household to reflect the 2022-2023 trend evident in Current Population Survey data. We also impose a constraint that no housing type-specific average household size can change by more than 0.09 persons per household relative to its 2020 value estimated previously. As with occupancy rates, this smooths out occasional rapid swings in ACS data that could be an artifact of sampling error.

To arrive at the final average household size, we calculate the overall average household size (regardless of housing type) from the housing type-specific figures and average them with the 2020 Census average household size as well as the average household size calculated by extrapolating the 2010-2020 trend. Then we adjust the housing type-specific average household sizes to match that average.

Local average household sizes

Average household sizes for each type of housing in each community are calculated in the same way as the county-level figures described previously.[7] We then adjusted them to align with the county-level average household sizes estimated as described above.

Population in households calculated

Estimates of households, segmented by housing type, are multiplied by housing-type-specific persons per household (PPH) multipliers. The product is the population in households:

Population in Households = $\Sigma_{\text{housing type}}$ (Households $_{\text{h.t.}}$ X PPH $_{\text{h.t.,}}$)

That is, the estimated number of people in households for each city and township is the sum of:

- Households in single family detached units *multiplied by* average household size
- Households in townhome units *multiplied by* average household size
- Households in duplex/triplex/quadplex units *multiplied by* average household size
- Households in multi-family (apartment) units *multiplied by* average household size
- Households in accessory dwelling units (ADUs) *multiplied by* average household size
- Households in manufactured homes *multiplied by* average household size

Population in group quarters

We enumerate known group quarters in order to account for persons living in institutional or non-household settings. The list of group quarters has been refreshed in light of the 2020 Census results; see Appendix B for a description of how we did this. These facilities are surveyed annually, and the resulting counts fully replace the counts from previous years and from the 2020 Census.[8]

Total population

The total population estimate adds together the household population estimate with the group quarters population estimate:

Total Population = $\Sigma_{\text{housing types}}$ (Households $_{\text{h.t.}}$ X PPH $_{\text{h.t.}}$) + Group Quarters Pop

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[7] The only exception is that we halve the constraint on year-to-year change in average household size for any given household type, from 0.09 to 0.045 persons per household. This is to avoid large swings that can be generated from small sample sizes in the ACS.

[8] If a survey for a facility is not returned and field follow-up does not result in participation, we carry over the group quarters population from the previous annual survey.

Maintenance of the model

The Council's model is maintained as a set of R programs that load data from input tables, perform calculations, and compile the results.

Input tables include minor-civil-division data on:

- Metropolitan Council's estimation of 2020 housing units, segmented by type
- Permitted housing units, segmented by housing type
- Other gross changes, segmented by housing type
- Manufactured home counts
- 2020 Census counts
- The most recent Census ACS occupancy rates and persons-per-household multipliers
- Counts of residents in group quarters facilities

Appendix A: Estimating the 2020 housing stock

Our estimates model relies on housing type as an important piece of information about the likely occupancy and number of people living in each housing unit. Unfortunately, the 2020 Census did not ask respondents what kind of home they live in, so numbers of housing units by type need to be inferred.

To do this:

- We classified each parcel in the *Regional Parcel Dataset* as one of several types: single-family detached units, townhomes, units in duplex/triplex/quadplex buildings, and units in multifamily buildings with five or more units, or non-residential.
- We based these classification decisions on the characteristics of parcels, such as the use classification and type of structure, as well as information from two proprietary data sources (CoStar and Zillow's ZTRAX).
- Where this information was not sufficient to classify parcels with confidence, we consulted aerial imagery, Google Street View, and our building permit data to develop decision rules.
- We then added data on manufactured homes from our annual manufactured housing park survey.
- We added up all the parcel-based housing unit counts within each jurisdiction and calculated the percentage of all units that belonged to each housing type.

Finally, we multiplied the 2020 Census housing unit counts by these percentages. For example, if the 2020 Census showed 1,000 housing units in a city, and the parcel dataset suggested that 75% of that city's housing units were single-family detached, then we estimated 750 single-family detached housing units in that city.

Appendix B: Refreshing group quarters facilities lists

Each year, we survey group quarters (GQ) facilities in the region to determine their population. We keep our list as up-to-date as possible: our survey usually informs us when facilities close, and we ask communities to report new GQ facilities in our (separate) survey of residential construction. We cannot know about all changes, though, because we depend on others to report these changes to us. Accordingly, we refresh our list following each decennial census. This ensures that our subsequent population estimates are as consistent as possible with the 2020 Census.

Unfortunately, the 2020 Census provides only block-level counts of GQ facilities and residents. (The Census Bureau's full list of GQ facilities is confidential.) Accordingly, we needed to build our own list by inspecting each block manually.

First, we identified the blocks to inspect.
- We gathered a list of all census blocks with any group quarters population according to the 2020 Census.
- We maintain GIS data on the spatial location of each facility in our list. We identified the census block in which each of these facilities fell.
- We checked each of the 2,421 blocks where the Census Bureau and/or the Metropolitan Council recorded group quarters residents and attempted to determine the facility or facilities that might be considered group quarters, using the following sources:
  - Number of residents in each type of group quarters facility (according to the Census Bureau)
  - Number of housing units and group quarters facilities in each block (according to the Census Bureau)
  - County parcel data
  - Internet searches
  - Previous Metropolitan Council GQ survey data
  - Aerial imagery
  - CoStar (a proprietary source of multifamily residential data)
  - Licensing data from the Department of Human Services

Based on the results of that inspection, we then decided whether to include each of these facilities in future population estimates:
- Facilities we will include in future group quarters population estimates
  - Facilities on our list that also appeared to be classified as group quarters in the 2020 Census.
    - For some smaller facilities on our list, we had been using the licensed capacity from Department of Human Services data as the population in pre-2020 estimates. This capacity sometimes exceeded the 2020 Census GQ population of the facility's block; in these situations, we assigned the 2020 Census block GQ population.
  - Facilities on our list that the Census Bureau did *not* classify as group quarters in the 2020 Census, as long as they meet all of the following conditions:
    - They are still open (or may have opened after April 1, 2020)
    - They meet the criteria for group quarters
    - They were not classified as housing units instead in the 2020 Census
  - The 2020 Census plan originally included an opportunity to identify and enumerate these missing facilities, but this operation was canceled when the previous presidential administration abruptly changed the deadline for completing the 2020 Census data collection.
  - Facilities not on our list that the Census Bureau classified as group quarters

- These were surveyed starting in 2023, and the GQ population in the 2023 estimates reflects those numbers.
    - Collections of group quarters residents in census blocks where we could not identify a group quarters facility:
        - In some census blocks, the Census Bureau reported substantially more group quarters residents than our survey suggested there were.
        - Some of these lacked any residential buildings but did have buildings like food shelves, where unsheltered people may have been enumerated during the day.
        - Others lacked any buildings at all. This included, for example, several parks in Minneapolis, where the Census Bureau presumably counted people in encampments.
        - Still others simply contained substantially more group quarters residents than were reported to us in our annual survey.
        - To ensure that our estimates would still include these residents and remain comparable to the 2020 Census, we treated each block as its own facility and used the 2020 Census GQ population counts (subtracting the population from any existing facilities reported to us in our survey). For example, one block in Oakdale had 103 GQ residents according to the 2020 Census, but our survey showed only 53. We took the remaining 50 GQ residents and added them to Oakdale's population estimate.
- Facilities that will not be included in future group quarters population estimates
    - Facilities on our list that are now closed
    - Facilities on our list that were enumerated as housing units instead of group quarters

As noted above, our estimates and the 2020 Census disagree on the type of housing in some cases.
- For example, facilities for older adults often contain memory care or skilled nursing units (which are considered group quarters) as well as independent/assisted living units (which are considered housing units).
- We prioritize consistency with the 2020 Census:
    - Even if the Census Bureau erroneously classified independent/assisted living units as group quarters, we treat them as group quarters as well.
    - Even if the Census Bureau erroneously classified memory care or skilled nursing units as housing units, we treat them as housing units as well. These residents will still show up in the population estimates -- just as part of the household population instead of the group quarters population.
    - In a small number of census blocks, the entire population appears to have been enumerated as *both* housing units and group quarters. We prioritize the consistency of housing unit numbers and treat these residents as living in households and *not* group quarters.