

Appendix C. Regional Housing Needs Assessment Technical Methodology

Introduction

The Denver Regional Council of Governments (DRCOG) seeks to develop a methodology for a regional housing needs assessment to understand baseline needs and improve regional coordination on housing planning and production. Colorado does not currently mandate a specific methodology for assessing housing need at any jurisdictional level, though many local governments do undertake such analyses on an ad hoc basis. This project serves as a foundation both for regional level-setting and future analysis and methodological refinement. As such, the project team's methodology is as important to document and explore as its findings.

This memo is technical in nature. It is written for an audience familiar with demographic forecasting, housing market function, and the data that are generally used to understand and project housing need. The final report summarizes the results for decision-makers and other interested parties, and incorporates the results of stakeholder engagement that were conducted concurrently with this assessment.

Measuring regional need

A regional housing needs assessment estimates the number of households in each income category across the Denver region that will need dwelling units that are affordable to them, now and through 2050. This memo summarizes the project team's methodology for accomplishing this goal, with a focus on the primary methodological decisions and key assumptions used.

The methodology describes the source data, components of the assessment, and the analytical steps to calculate housing need.

Data sources

The choice of datasets is fundamental to the methodology's ability to achieve its guiding principles. ECONorthwest and DRCOG evaluated available data sources, including national, state, and regional sources, and built on past experience with regional housing needs assessments. We determined that the most appropriate primary data source is 1-year Public Use Microdata Sample from Census (PUMS), as it provides annually updated data that is more accurate and reliable than other options available at the regional level. PUMS provides more current data than other sources we considered, such as the Comprehensive Housing Affordability Strategy (CHAS) or the 5-year sample of the American Community Survey (ACS). The Census Bureau produces the PUMS files so that data users can create custom tables that are not available through pre-tabulated (or summary) ACS data tables. PUMS are available for geographies of about 100,000 people, called Public Use Microdata Areas (PUMAs). The Denver region has 25 PUMAs.



ECOnorthwest supplemented PUMS data with several other sources:

- ◆ **Colorado State Demography Office**—a division of the Department of Local Affairs (DOLA)—population (2022), household (2022), and employment (2020) forecasts.
 - DRCOG provided the project team with a modified version of the 2022 household forecast. The initial total number of households by age group and household size is derived from a synthetic population generated from the 2013 5-year PUMS estimates. Growth rates by age group and household size from the State Demography Office’s forecast are used to calculate household counts through 2050. DRCOG then adjusted the county-level distribution of households based on housing development data from Zonda and CoStar in 2022 to 2024 to shift household growth to higher unit growth counties. Finally, DRCOG makes a small adjustment to the regional household count in each year to account for differences in persons per household between the State Demography Office forecast and DRCOG’s synthetic population.
- ◆ **DRCOG** small-area forecast for households and employment from 2020. The household and employment totals in the forecast are based on the forecasts from the State Demography Office. The household incomes in the small-area forecast are based on 2013 5-year PUMS data.
- ◆ **Metro Denver Homeless Initiative (MDHI)** State of Homelessness Report, 2022–2023 provided data about the number of people experiencing homelessness in the region.
- ◆ U.S. Census Bureau’s **Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics (LODES)** from 2020 helped identify regional submarket geographies.
- ◆ Rental market data from **CoStar** informed assumptions about the price filtering of multifamily housing over time.
- ◆ U.S. Census Bureau’s Building Permit Survey and DOLA’s Municipal Housing Estimates, 2010–2020 informed assumptions about the rate of residential building demolition.

Key metrics

In addition to demographic and housing stock data, the methodology uses measures of housing market function, such as vacancy and affordability, throughout the process. The details of these metrics are described below.

Vacancy measures

This analysis uses different measures of vacancy throughout the process, depending on context and intended comparison.

- ◆ **Historic rate:** The observed *historic rate* of vacancy—4.7 percent—is the 75th percentile of national vacancy between 1980 and 2010 (using decennial Census and ACS 1-year



data at the Metropolitan Statistical Area level). ECONorthwest used this rate to measure underproduction in order to compare the current supply to the amount of housing that would have kept pace with national vacancy trends.

- ◆ **Observed rate:** The current *observed rate* of vacancy of 6.5 percent is reported in ACS 1-year data, with second and vacation homes removed. ECONorthwest used this rate to compare submarket vacancy rates with current national trends to identify areas with housing markets that are more constrained than average.
- ◆ **Target ratio:** The *target ratio* of 1.072 housing units per household—or roughly 7 percent vacancy—comes from scholarly literature about adequate vacancy to support a more flexible housing market, with greater affordability. ECONorthwest used this ratio when calculating future housing demand so as not to project a currently constrained housing market into the future.

Housing affordability

Matching households to available housing units based on income requires a crosswalk from household income to reported prices for both owned and rented housing.

- ◆ **Owned units:** The affordability of owned units is calculated using a price-to-income ratio of 3.36, where the income needed to afford a home is 3.36 or more of the home's reported value. U.S. HUD uses this ratio to measure housing affordability in its Comprehensive Housing Affordability Strategy (CHAS) data, and is based on underwriting requirements for the Federal Housing Administration's loan insurance programs.¹
- ◆ **Rented units:** We use U.S. HUD's standard of rental affordability, where housing costs cannot exceed 30 percent of a household's gross income.²
- ◆ **Adjusting for unit size:** By default, AMI measures assume a four-person household. To better match units to households by income, ECONorthwest adjusts the affordability of a unit based on the number of bedrooms using U.S. HUD's adjustment factors, summarized in Exhibit 1. This adjustment prevents an overestimation, for example, of one-bedroom units affordable to a four-person household that could not comfortably occupy that unit. ECONorthwest applies these adjustment factors to each housing unit observation in the PUMS data to determine the income needed to afford that unit. For a one-bedroom unit, the household income that could afford the unit is 75 percent of the income needed to afford the nominal rent, assuming U.S. HUD's affordability standard of 30 percent of gross income.

¹ Paul Joice, "[CHAS Affordability Analysis](#)." U.S. HUD, working paper, May 20, 2013.

² U.S. HUD programs include utility costs in total housing costs. Our analysis considers only reported rental prices.



Exhibit 1. HUD multipliers to adjust housing affordability

Number of Bedrooms	0	1	2	3	4	5
Adjustment Factor	0.70	0.75	0.90	1.04	1.16	1.28

Source: U.S. HUD

Components of housing need

The estimation of total regional need derives from three component parts: future need, underproduction, and units to address homelessness. The details of these components are described below.

Future need

In this analysis we calculate the total units that will be needed to accommodate the population in 2050. Population forecasts provided by the State Demography Office account for natural population changes from birth rates (fertility) and death rates (mortality) and migration-related population changes from people moving in and out of a region. The study of demographics is complex and factors in macroeconomic statistics like fertility rates, health and longevity rates, the racial and ethnic makeup of the region, and other factors.

We compare the estimate of the total households that will need housing in 2050 to the current supply of housing. We assume that the current supply will carry forward, with some loss due to demolitions as buildings age out of their useful life. This approach does not assume a rate of housing production or number of units that will be built over the planning horizon based on past trends. Because the Regional Housing Needs Assessment is intended to support housing planning and policy, understanding current and future need in total is crucial. Assuming a rate of production results in discounting or underestimating that future need in ways that can perpetuate underproduction and an overall shortage of housing.

Future need is calculated using the following steps:

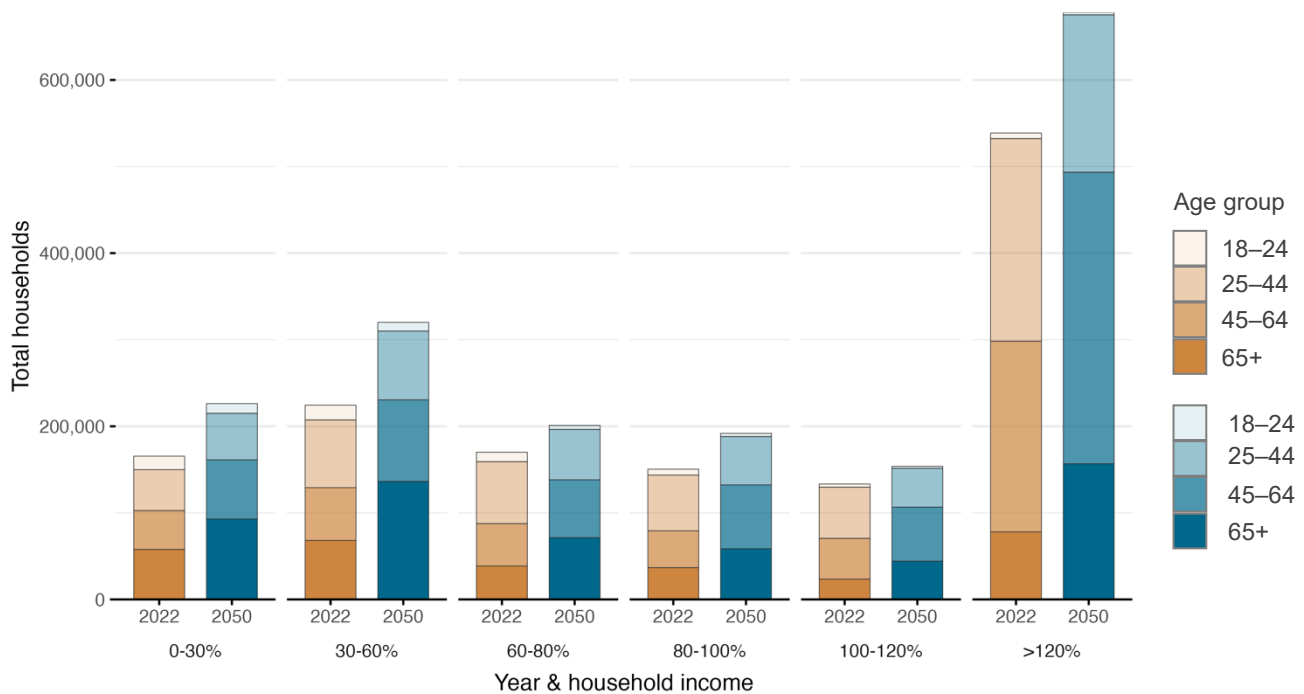
- ◆ **Future households.** The project team used data from the State Demography Office, provided and modified by DRCOG, for projected household growth through 2050. DRCOG adheres to the official regional projections of the Colorado State Demography Office for all modeling associated with the DRCOG small-area forecasts, making only minimal adjustments.
- ◆ **Future housing gap.** We project the current supply of housing into 2050, with adjustments to account for units that cannot be occupied and those that will be lost over time to demolitions. The assessment of occupiable units—or the current housing supply—removes homes designated in Census data as second or vacation homes and homes lacking complete plumbing and kitchens, since those units are not available for long-term occupancy. The project team assumed that 0.1 percent of units will be lost each year to demolitions due to the age and diminished value of the structure. This is roughly equivalent to the national rate of demolition. Because units more likely to be demolished are older or in disrepair, and thus likely to be more affordable, all



demolished units are taken out of the supply distributed to the lowest income segments in the next step. ECONorthwest then multiplied future households by a target ratio of households to housing units of 1.072 (or roughly 7 percent vacancy) to arrive at the target supply of housing units. The difference between the target supply and the projected future supply is the total future housing need.

- ◆ **Unit income distribution.** DRCOG’s small-area forecasts include nominal household income, which allowed the project team to model the future distribution of incomes across the Denver region. DOLA’s control total household forecasts are cross-tabulated by householder age and household size, as are DRCOG’s small-area forecasts. Using this connection, ECONorthwest applied the income distributions by household size and age (converted to percent-of-AMI using 2013 data on regional AMI) from the small-area forecasts to the regional DOLA household forecast. Exhibit 2 illustrates this shift in the income distribution by age between 2022 and 2050 using household estimates for which householder age and income data is available, from PUMS and DRCOG small-area forecasts.

Exhibit 2. Householder Age Distribution by Income, 2022 and 2050



Source: 2022 distribution based on U.S. Census Bureau, ACS 1-year 2022 PUMS. 2050 distribution based on DRCOG Small-Area Forecast (2020), and DRCOG synthesis of State Demography Office 2022 Household Forecast.

ECONorthwest also adjusted the affordability of units to account for market filtering over time. Based on an internal analysis of regional housing stock using CoStar rent and building data, ECONorthwest assumed that rental housing units reduce in price by 0.4 percent of AMI per year (e.g., a unit affordable at 50 percent AMI today will be affordable



at 46 percent AMI in 10 years). A separate analysis of ownership housing units using regional assessor’s data indicated no region-wide price filtering of owned housing units.

Underproduction

Underproduction, or the lack of enough units to meet demand, is a key reason that housing markets experience rising prices. Accounting for current underproduction is a key feature of the Regional Housing Needs Assessment methodology. This component accounts for the number of housing units that are not available, but should be if the region had produced enough units each year to match the historic national vacancy rate of 4.7 percent. If the region has not met this threshold, housing is likely too scarce and prices will rise. Households with the lowest incomes will struggle most to find scarce units, cost burdening will increase, and rates of homelessness may also increase. In other words, underproduction leads to cost burdening.

There are a few approaches to identifying a housing shortage. One way that is commonly used because it can be completed at the city-level given available data sources, is to identify all households that are cost burdened in each geography, with an assumption that each cost-burdened household needs a unit that is affordable to them. Yet simply summing the number of cost-burdened households and calling that a “housing shortage” projects an oversupply of housing in the market, because cost-burdened households do have existing units, even if they are not sorted into those units by income in ways that they can afford. This is the reason that the Regional Housing Needs Assessment does not use this method to identify the shortage of housing. The cost-burden method is a useful way to understand the shortage of affordable units in a market and adds helpful information to inform housing production policies. It is not, however, a satisfactory way to understand the number of units that are needed in an entire housing market.

ECONorthwest’s methodology takes a different approach to the shortage analysis: it identifies the number of units that would be needed to achieve a sufficient balance of units to current residents—including households that have not formed due to limited housing options—and then categorizes those units across the current distribution of household income. This approach recognizes that underproduction in a housing market results in greater cost burdening for lower-income households. The analysis of underproduction and housing for people experiencing homelessness serves the purpose of estimating housing needed to meet immediate housing needs, primarily for the lowest-income residents.

Current underproduction is calculated using the following steps:

- ◆ **Current households.** The current number of households is calculated using ACS 1-year 2022 PUMS data and an analysis of missing households. Missing households represent residents who are currently sharing housing—for example, young adults living with parents or adults living with roommates—who would otherwise occupy their own units if there were additional housing supply that they could afford. ECONorthwest calculated the number of missing households for age cohorts using a baseline measure of headship rates in 2000. These 2000-era householder rates are calculated for each 10-year age cohort using decennial Census data. The rates are then applied to the 2022 PUMS-derived population of the same age cohorts to calculate the estimated number of



households the region *would* have today under pre-recession economic conditions. This hypothetical estimate is then compared against the actual total number of households by age cohort. Where the actual number of households is less than the hypothetical target, the difference is the number of missing households.

- ◆ **Target supply.** The region’s current number of households, combined with missing households, is multiplied by a historic national vacancy rate of 4.7 percent to arrive at the target supply of housing units. Underproduction occurs when the total number of occupiable units in a region is less than the target supply. Units that represent current underproduction are subtracted from the total future need calculated for the future need component.
- ◆ **Unit income distribution.** Because underproduction leads to cost burdening in the market, the effects of underproduction are most acutely felt by those with lower incomes who need access to affordable housing now, in today’s market. In this analysis, underproduced units are distributed into percent-of-AMI income bins proportionate to the income distribution of cost-burdened renter households in the region, as reported in PUMS data.

Homelessness need

The second component of regional need is the calculation of units needed for the population currently experiencing homelessness. This is a key feature of the recommended methodology. Populations experiencing homelessness are generally not captured in foundational datasets derived from the Census because the Decennial Census and the American Community Survey rely on counting and sampling people with addresses, which those struggling with homelessness may not have. These people are also not accounted for in estimates of underproduction that rely either on a target vacancy rate or a national ratio of housing units to households—nationally, many communities struggle with homelessness despite having an average vacancy rate or an overall ratio of 1.072 housing units for every household.

Determining unit need for homeless residents required particular attention, because available datasets have many limitations, most importantly undercounting populations. We relied heavily on the limited research that is available on this topic, and discussion with DRCOG staff and stakeholders with expertise in research and providing services for those experiencing homelessness in the Denver region.

Housing to address homelessness is calculated using the following steps:

- ◆ **Total homeless households.** We used data from the Metro Denver Homeless Initiative (MDHI) State of Homelessness Report, 2022–2023 to estimate the number of households experiencing homelessness. MDHI data is calculated from a combination of Point-in-Time count data as well as tracking the number of people accessing services from providers across the region. MDHI’s State of Homelessness Report tabulated total individuals seeking services and individuals in families as a subtotal. ECONorthwest converted the individuals-in-families subgroup to households using the regional persons per household (as observed in PUMS data), and assumed the remainder are single-person households.



- DRCOG staff have indicated that they intend to continue discussions with MDHI to learn more about what information MDHI and its partners collect for their operational and strategic planning purposes. In addition to ways additional discussion might inform future housing strategy development, DRCOG staff may also identify opportunities to use the information collected across MDHI's Continuum of Care to refine the above process for future assessments of housing need.
- ◆ **Unit income distribution.** There is no existing, quality dataset with information about the incomes of people who are experiencing homelessness, but we know that many households that are experiencing homelessness have incomes and still cannot find an available home that is affordable to them. Based on the literature and ECONorthwest's experience assessing housing needs in other regions, the project team distributed all units needed to address homelessness to the lowest income segment of 0–30 percent of AMI.

Additional considerations

In addition to the principal components discussed above, the project team considered other demographic trends and housing supply factors as part of the Regional Housing Needs Assessment methodology. These factors were not incorporated into the methodology at this time, for reasons explained below. As DRCOG continues to refine its approach to the Regional Housing Needs Assessment, update data sources, respond to changing conditions, and incorporate new or additional policy priorities, there may be a place for these and other factors in future assessments.

- ◆ **Demand for second and vacation homes:** When planning for future housing need, any loss of units to second and vacation homes effectively requires building more units to keep up with household formation. Units lost to second and vacation homes can occur through conversions of existing housing stock but could also include some purpose built second and vacation homes. The project team evaluated the trends in the stock of second and vacation homes in the Denver region to determine whether to include demand for these units into the model. Currently, second and vacation homes are a very small share (generally less than 2 percent) of homes across the Denver region, with a slightly larger share in mountain communities in the west (approximately 7 percent). Across the region, the share of second and vacation homes has been declining over time. Given these figures, the project team did not include loss of future units to second and vacation homes as a variable in the model for future need. Second and vacation homes are removed from the current stock of available housing for the purposes of estimating current needed units compared to households (i.e., underproduction).
- ◆ **Induced or reduced in-migration:** If jurisdictions in the Denver region build housing and make progress toward increasing supply, the region may become more affordable and competitive relative to other metro areas. A more affordable housing market may spur more migration to the region than is accounted for in the State Demography Office's population growth projections, including from nearby counties from which people already commute to the region for work. Given that this modeling relies on the performance of other metro area housing markets relative to the Denver region's, the



project team did not undertake the extensive modeling necessary to account for this potential effect. Additionally, the converse could occur if the Denver region sees in-migration levels below what the State Demography Office forecasts for the region to maintain a labor force sufficient to help make up for residents projected to age out of their prime working years, which could occur if progress is not made toward increasing supply. Because the Regional Housing Needs Assessment will continue to be updated with new data and evolve over time, future assessments will incorporate growth trends captured in the state’s population growth methodology, including changes in migration.

- ◆ **Land capacity:** The Regional Housing Needs Assessment estimates the need for housing based on current and future population trends and distributes that need across the region based on demographic factors, features of the housing market, and regional transportation resources. The project team also adjusted the distribution of needed housing to accommodate varying shares of water and protected open space across the region. The Regional Housing Needs Assessment does not include more granular information about developable land. The project team recognizes that cities in the region face varied on-the-ground conditions, such as the supply of land, infrastructure, access to water, and other considerations. Many of these issues relate to policy choices about how to use land to meet community needs. The Regional Housing Needs Assessment provides information to support DRCOG and its member jurisdictions to address these varied challenges to help meet the regional need for more housing.

Results

The following Exhibits present the results of the Regional Housing Needs Assessment for a time horizon of 2023–2050 and a 10-year scaled estimate.

Exhibit 3. Summary of Housing Need by Component, 2023–2050

FUTURE NEED	UNDERPRODUCTION	HOMELESSNESS NEED	TOTAL UNITS
458,896	26,330	26,394	511,620
90%	5%	5%	100%

Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022–2023 State of Homelessness Report.

Exhibit 4. Housing need components by income, 2023–2050

COMPONENT OF NEED	0–30%	30–60%	60–80%	80–100%	100–120%	>120%	TOTAL
Future need	138,435	118,798	16,527	72,542	24,820	87,774	458,896
Underproduction	9,377	10,176	4,704	1,340	732	–	26,330
Homelessness need	26,394	–	–	–	–	–	26,394
Total	174,206	128,974	21,231	73,882	25,552	87,774	511,620



Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022–2023 State of Homelessness Report.

Exhibit 5. 10-Year scaled estimate of housing need

FUTURE NEED	UNDERPRODUCTION	HOMELESSNESS NEED	TOTAL UNITS
163,891	26,330	26,394	216,615
76%	12%	12%	100%

Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022–2023 State of Homelessness Report.

Exhibit 6. 10-Year scaled estimate of housing need components by income

COMPONENT OF NEED	0–30%	30–60%	60–80%	80–100%	100–120%	>120%	TOTAL
Future need	49,441	42,428	5,902	25,908	8,864	31,348	163,891
Underproduction	9,377	10,176	4,704	1,340	732	–	26,330
Homelessness need	26,394	–	–	–	–	–	26,394
Total	85,212	52,604	10,606	27,248	9,596	31,348	216,615

Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022–2023 State of Homelessness Report.

Note: Components of need do not sum to total because of rounded unit counts.

Exhibit 7. 2023 Supply of housing units and future demand by income, 2050 and 10-year scaled estimate

TIME HORIZON	0–30%	30–60%	60–80%	80–100%	100–120%	>120%	TOTAL
2023 Supply	104,069	224,311	199,039	133,118	140,029	612,485	1,413,051
2050 Demand	278,275	353,285	220,270	207,000	165,581	700,259	1,924,670
10-Year scaled estimate demand	189,281	276,915	209,645	160,366	149,625	643,833	1,629,665

Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022–2023 State of Homelessness Report.

Submarket share of regional need

While the Regional Housing Needs Assessment produces an aggregate estimate of current and future housing needs for the entire Denver region, effective planning and policy to achieve that housing will happen within more localized geographies. To understand how total need could be distributed across the region to align with growth trends, local needs, and DRCOG’s Metro Vision,



the project team distributed total need among five regional submarkets. The result is an estimate of the number of needed housing units by income for five submarkets within DRCOG’s service area (which this report refers to as the submarket *share* of housing need).

Submarket geographies

Once the project team identified PUMS as the best available data source for the Regional Housing Needs Assessment, defining submarkets using PUMAs offered the best option to move between the regional and submarket levels with consistent data sources and boundaries.

Key methodological decisions

The project team considered two approaches to defining submarkets: 1) creating contiguous areas or 2) defining non-contiguous submarkets by demographic or planning conditions, such as grouping urban centers (as defined in Metro Vision) together. The project team decided to define submarkets as contiguous areas to better reflect how regional housing submarkets function and support potential future collaboration between neighboring and nearby jurisdictions to address shared housing needs.

ECONorthwest conducted a cluster analysis using multiple statistical methods to create draft maps of contiguous market areas. The project team determined that five clusters captured meaningful differences across the region while not overcomplicating the analysis (and future development of targeted strategies). Specifically, the project team used two primary methods to identify potential PUMA-based submarkets: 1) a SKATER algorithm to identify similar areas based on demographic data, and 2) the Walktrap network clustering analysis informed by commute patterns using origin-destination data from LODS (2020). The SKATER analysis used the following inputs all pulled from PUMS 2022 1-year data:

- ◆ Share of population earning below 80 percent of Area Median Income (AMI)
- ◆ Share of renters and share of cost-burdened renters (paying more than 30 percent of total income in housing costs)
- ◆ Average household size
- ◆ Share of households with children
- ◆ Share of households older than 64
- ◆ Share of multifamily housing
- ◆ Average home value
- ◆ Average gross rent
- ◆ Share of renter households

The draft maps produced through these analyses are shown in Exhibit 8. After conducting independent SKATER and Origin-Destination analyses, the project team decided to use clusters informed by commute patterns. This version of submarket geographies was then manually adjusted by the project team to reassign two PUMAs into a fifth submarket to separate the rural

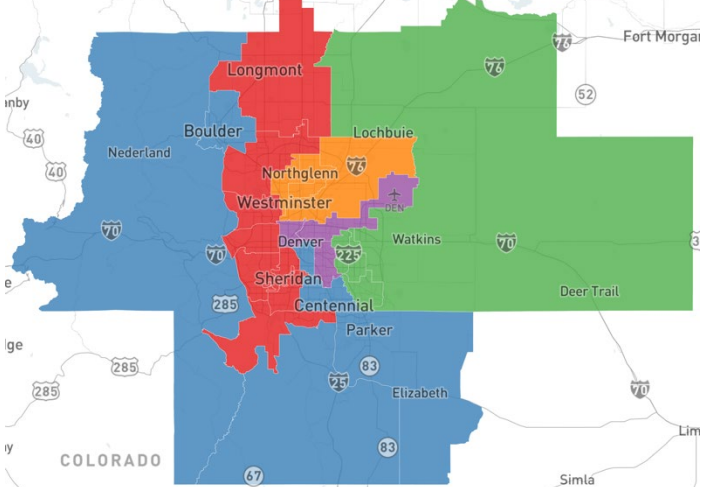
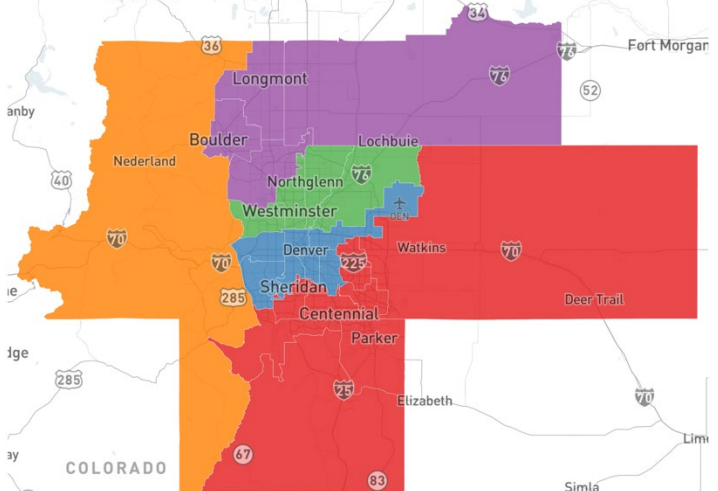


mountain areas in the west as a distinct submarket. The project team also made a manual adjustment to avoid splitting two large jurisdictions into separate submarkets.

Exhibit 8. Submarkets considered in the analysis

SUBMARKETS CONSIDERED	METHOD AND CONSIDERATIONS
<p>A map of Colorado showing submarkets defined by SKATER analysis. The map is divided into several color-coded regions: a large purple region in the west (including Longmont, Boulder, Nederland, and parts of Fort Morgan), a large red region in the east (including Northglenn, Westminister, Denver, Centennial, Parker, and Deer Trail), a green region in the south (including Elizabeth and Parker), and a small blue region in the center (including Denver and Sheridan). Major highways like I-70, I-76, I-225, and I-25 are shown.</p>	<p>SKATER (Spatial ‘K’luster Analysis by Tree Edge Removal)</p> <p>This version of K-means analysis seeks to reduce the total variation of all demographic variables within the specified number of submarkets, with the requirement that clusters are spatially contiguous.</p>
<p>A map of Colorado showing submarkets defined by Origin-Destination Clustering. The map is divided into several color-coded regions: a purple region in the west (including Longmont, Boulder, Nederland, and parts of Fort Morgan), a red region in the east (including Northglenn, Westminister, Denver, Centennial, Parker, and Deer Trail), a green region in the south (including Elizabeth and Parker), and a blue region in the center (including Denver and Sheridan). Major highways like I-70, I-76, I-225, and I-25 are shown.</p>	<p>Origin-Destination Clustering</p> <p>This analysis used origin-destination information from LODES to implement the Walktrap network clustering algorithm that uses the flow to jobs as weights. Like SKATER, this network analysis was designed to find statistically-significant clusters.</p>



SUBMARKETS CONSIDERED	METHOD AND CONSIDERATIONS
	<p>Origin-Destination informed SKATER</p> <p>This analysis attempted to synthesize the two algorithmic methods by including the number of commutes from each PUMA to each Origin-Destination cluster identified in the Walktrap method as an additional input to the SKATER model, alongside the demographic variable inputs used in the original SKATER clustering model.</p>
	<p>Revised Origin-Destination Clustering—final map for the Regional Housing Needs Assessment</p> <p>This revised map reassigned 2 PUMAs in the Origin-Destination clustering map to create a fifth submarket. This map preserves Denver within a single submarket and creates a distinct submarket for the mountain areas in the west.</p>

Source: ECONorthwest; ACS 1-year 2022 PUMS data; LODES 2020.

Distributing regional need among submarkets

In consultation with DRCOG staff and the advisory group, ECONorthwest created a model for distributing the 10-year scaled estimate of the Regional Housing Needs Assessment results among the five submarkets based on criteria that reflect both current conditions and needs and forecasted future conditions and needs. The criteria include factors that shape the demand for housing and align with regional planning goals for greater affordability across the region and matching growth with multimodal transportation systems. At a high level, the categories and rationale behind the criteria are as follows:

- ◆ **Population:** Housing need corresponds directly to population size.
- ◆ **Regional jobs:** Employment is a driver of housing demand. Better matching of job and housing locations creates more options for housing, shortens commute times and distances, and eases congestion and vehicle travel on the region’s transportation systems.



- ◆ **Multimodal accessibility:** Metro Vision outlines a plan for more compact urban development and a greater use of transit, walking, and biking for daily activities.
- ◆ **Housing availability:** Low rental vacancy rates help illuminate places where housing is particularly in high demand and short supply, relative to the region as a whole.
- ◆ **Housing affordability:** Every community in the Denver region has a role to play in planning for housing affordable to a range of incomes. Areas with a smaller supply of affordable housing contribute to regional inequities in access to opportunity and suboptimal transportation outcomes.

Exhibit 9 summarizes the criteria included in the model, the method of calculating and applying each criterion, and the data source for each input.

Exhibit 9. Summary of Distribution Criteria for Submarket Share of Total Housing Need

CRITERION	METHOD	DATA SOURCE
Current conditions		
Share of regional population, 2022	Positive weight	DRCOG Small-Area Forecast (2020)
Share of regional jobs, 2022	Positive weight	DRCOG Small-Area Forecast (2020)
Share of pedestrian/transit-accessible jobs and households (< 0.5 miles)	Calculate travel distance of each census block to nearest transit amenity in RTD data; positive weight	DRCOG Pedestrian Focus Areas
Share of housing units needed to meet national vacancy rate	Calculate gap between submarket vacancy and the observed national rate of 6.5 percent; inverse weight	ACS 1-year 2022 PUMS
Share of region's affordable units (0–60% AMI)	Inverse weight	ACS 1-year 2022 PUMS
Future conditions		
Share of regional population, 2033	Positive weight	DRCOG Small-Area Forecast (2020)
Share of regional jobs, 2033	Positive weight	DRCOG Small-Area Forecast (2020)
Share of developable land proximate to planned Rapid Transit System network	Calculate share of land within 0.5 miles of the RTS network and Pedestrian Focus Areas, removing protected open space and water; positive weight	DRCOG RTP 2050 Network
Share of "short" commutes	Share of commutes under 30 minutes; positive weight	ACS 1-year 2022 PUMS

Broadly, the inputs that reflect current conditions distribute the units of the Regional Housing Needs Assessment that represent current needs—those for underproduction and homelessness.



Inputs that reflect future conditions distribute the future needs component of the results. The model weights each of the current and future conditions inputs equal relative to one another and distributes units to submarkets based on each submarket’s share of each input.

The example below illustrates the steps in this method using the future condition input related to future transit access:

1. The share of developable land proximate to planned Rapid Transit System determines 25 percent of future need (100 percent divided equally among four inputs).
2. The Central submarket has 37 percent of the land proximate to the planned Rapid Transit System network.
3. The Central submarket will receive 37 percent of 25 percent of the total regional future need from this input.

Results

Exhibit 10. Summary of submarket share of regional need by phase, 10-year scaled estimate

SUBMARKET	HOMELESSNESS NEED	UNDERPRODUCTION	FUTURE NEED	TOTAL UNITS
Central	7,110	7,093	56,047	70,250
North	4,219	4,209	28,710	37,138
North Central	3,509	3,500	27,167	34,176
Southeast	10,653	10,628	48,250	69,531
West	902	900	3,717	5,520

Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022–2023 State of Homelessness Report.

Exhibit 11. Submarket share of regional need by income, 10-year scaled estimate

SUBMARKET	0–30%	30–60%	60–80%	80–100%	100–120%	>120%	TOTAL
Central	26,544	17,251	3,286	9,221	3,229	10,720	70,250
North	14,379	9,059	1,786	4,753	1,670	5,491	37,138
North Central	12,951	8,386	1,604	4,473	1,567	5,196	34,176
Southeast	28,994	16,598	3,636	8,168	2,905	9,229	69,531
West	2,344	1,310	295	633	226	711	5,520
Total	85,212	52,604	10,606	27,248	9,597	31,348	216,615

Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022–2023 State of Homelessness Report.

Note: Components of need do not sum to total because of rounded unit counts.



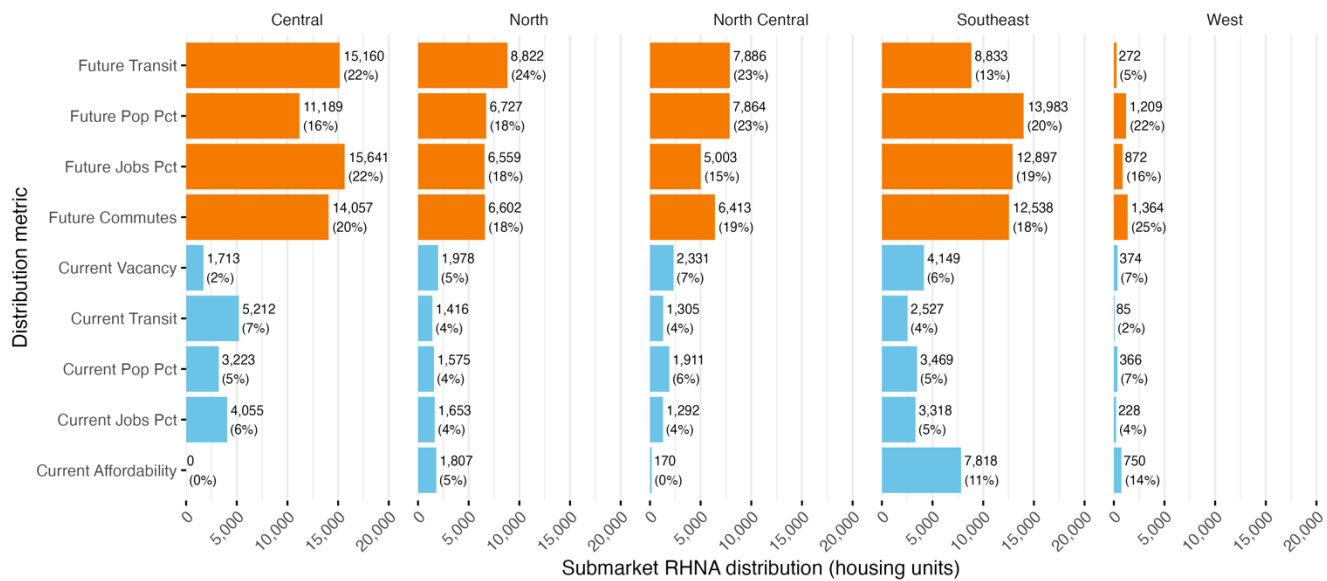
Exhibit 12. Submarket share of regional need by income and phase (current/future), 10-year scaled estimate

PHASE	0-30%	30-60%	60-80%	80-100%	100-120%	>120%	TOTAL
Central							
Current	9,636	2,741	1,267	361	197	-	14,203
Future	16,908	14,509	2,018	8,860	3,032	10,720	56,047
North							
Current	5,718	1,627	752	214	117	-	8,428
Future	8,661	7,432	1,034	4,538	1,553	5,491	28,710
North Central							
Current	4,755	1,353	625	178	97	-	7,009
Future	8,195	7,033	978	4,294	1,469	5,196	27,167
Southeast							
Current	14,438	4,107	1,899	541	296	-	21,281
Future	14,556	12,491	1,738	7,627	2,610	9,229	48,250
West							
Current	1,223	348	161	46	25	-	1,803
Future	1,121	962	234	588	201	711	3,717
Total	85,212	52,604	10,606	27,248	9,597	31,348	216,615

Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), State Demography Office Employment (2020) Forecast, DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022-2023 State of Homelessness Report.

Note: Components of need may not sum to totals above because of rounded unit counts

Exhibit 13. Submarket share of total need by distribution model criteria



Source: ECONorthwest analysis; DRCOG Small-Area Forecast (2020), State Demography Office Employment (2020) Forecast, DRCOG synthesis of State Demography Office 2022 Household Forecast, U.S. Census Bureau, ACS 1-year 2022 PUMS estimates; MDHI 2022-2023 State of Homelessness Report.

