LASS +CAP

LAND AVAILABILITY AND SUITABILITY STUDY + CODE ANALYSIS PROJECT

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT– DEVELOPMENT CODE DIAGNOSIS

JUNE 2024

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APPENDICES

ACRONYMS

ADA ..... Americans with Disabilities Act
ADOT ..... Arizona Department of Transportation
ADT ..... Average Daily Traffic
ADU ..... Accessory Dwelling Unit
AMI ..... Area Median Income
APS ..... Arizona Public Service Corporation
ARS ..... Arizona Revised Statutes
ATMP ..... Active Transportation Master Plan
BBB ..... Bed, Board, and Beverage
CAP ..... Code Analysis Project
Cascadia ..... Cascadia Partners LLC
CB ..... Central Business
CBECS ..... Commercial Building Energy Consumption Survey
CC ..... Community Commercial
CDR ..... Carbon Dioxide Removal
CIP ..... Capital Improvements Plan
City ..... City of Flagstaff
County ..... Coconino County
CO_2 ..... Carbon Dioxide
CO_{2e} ..... Carbon Dioxide Emission Equivalent
CS ..... Commercial Service
CUP ..... Conditional Use Permit
DA ..... Development Agreement
DOE ..... Department of Energy
DOWL ..... DOWL LLC
EPD ..... Environmental Product Declaration
ER ..... Estate Residential
EUI and WUI ..... Energy and Water Use Intensity
EV ..... Electric Vehicle
FAR ..... Floor Area Ratio
FCC ..... Flagstaff City Code
FRP ..... Flagstaff Regional Plan
FUTS ..... Flagstaff Urban Trails System
FZC ..... Flagstaff Zoning Code
GBD ..... GBD Architects Inc.
GHG ..... Greenhouse Gases
GIS ..... Geographic Information System
GWP ..... Global Warming Potential
HC ..... Highway Commercial
HCM ..... Highway Capacity Manual
HOH ..... High Occupancy Housing
HOHD ..... High Occupancy Housing Development
HR ..... High Density Residential
HVAC ..... Heating, Ventilation, and Air Conditioning
IBC ..... International Building Code
IDS ..... Inter Division Staff
IEA ..... International Energy Agency
IECC ..... International Energy Conservation Code

IFC ..... International Fire Code
IGCC ..... International Green Construction Code
IPAH ..... Incentive Policy for Affordable Housing
IPCC ..... Intergovernmental Panel on Climate Change
IRA ..... 2022 Inflation Reduction Act
IRC ..... International Residential Code
IRR ..... Internal Rate of Return
LASS ..... Land Availability and Suitability Study
LID ..... Low Impact Development
MAG ..... Maricopa Association of Governments
MH ..... Manufactured Housing
MR ..... Medium Density Residential
MUHOHD ..... Mixed Use High Occupancy Housing Development
NAU ..... Northern Arizona University
NBI ..... New Building Institute
NCC ..... Neighborhood Community Commercial
NREL ..... National Renewable Energy Lab
NWI ..... National Wetland Inventory
PRD ..... Planned Residential Development
PROSE ..... Parks, Recreation, Open Space, and Events
R1 ..... Single-Family Residential
R1N ..... Single-Family Residential Neighborhood
RMI ..... Rocky Mountain Institute
ROW ..... Right-of-Way
RPO ..... Resource Protection Overlay
RR ..... Rural Residential
SBUH ..... Santa Barbara Urban Hydrograph
SC ..... Suburban Commercial
SCS ..... Soil Conservation Service
SDC ..... System Development Charge
SF ..... Square Feet
State ..... State of Arizona
TDM ..... Transportation Demand Management
TIA ..... Transportation Impact Analysis
TMY ..... Typical Meteorological Year
TND ..... Traditional Neighborhood Development
TRP ..... Trip Reduction Plan
UGB ..... Urban Growth Boundary
USACE ..... United States Army Corps of Engineers
USFWS ..... United States Fish and Wildlife Services
USGS ..... United Sates Geologic Survey
VMT ..... Vehicle Miles Traveled
WSIA ..... Water and Sewer Impact Analysis
WUI ..... Wildland-Urban Interface

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT– DEVELOPMENT CODE DIAGNOSIS

EXECUTIVE SUMMARY

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1.0 EXECUTIVE SUMMARY

1.1 Project Overview and Objectives

The City of Flagstaff has recently adopted housing and carbon neutrality plans and is currently undertaking an update to its Regional Plan. Together, these policies represent a bold and forward-thinking vision to plan for the City's future. The Land Availability and Site Suitability and Code Analysis Project (LASS-CAP) was envisioned by City staff as a critical next step to review the regulatory framework that will be tasked with implementing this vision and assess any barriers exist to achieving the City's goals. The City's development code, building regulations, engineering standards, and transportation policies are critical tools in meeting Flagstaff's housing and climate goals.

The purpose of the LASS-CAP project is to both analyze these supporting codes and policies to identify where the codes may present barriers to these goals, while considering the context of what land is available for future development and redevelopment/infill. By having a fuller picture of priority sites for residential development and the current hurdles to development that would meet City housing and climate goals, Flagstaff can better prioritize recommended code changes and clearly articulate next steps to support future growth that advances its goals.

1.2 Policy Goals and Key Outcomes

Given the number and overlapping nature of goals related to housing and climate change across relevant City of Flagstaff documents and policies, the project team chose to focus on outcomes rather than strategies. The project team worked closely with City staff to translate policies, goals, and strategies from all relevant sources into an integrated set of "key outcomes". Outcomes articulate the end result Flagstaff would like to see. They are the manifestation of successfully accomplishing goals and represent the wide variety of strategies or approaches the City may take.

Outcomes also are useful benchmarks that can be used to evaluate development regulations. An emphasis on outcomes also accounts for a more holistic framework that uses the lenses of both housing and climate and accounts for potential overlaps or tensions between these two equally important objectives. A full list of these housing and climate outcomes is provided in Section 3. This integrated framework was the primary methodology used to analyze and assess the existing code regulations and identify barriers presented in this Code Diagnostic report.

1.3 Code Diagnostic Overview

The Consultant Team evaluated the City's development codes and processes using the key outcomes as a comprehensive framework for all the City's policy goals related to housing and climate. We assessed all sections of Flagstaff City Code (FCC) Titles 4, 5, 8, 10, 11, and 13 to identify regulations that pose a barrier to achieving these goals.

Using case studies of recent development projects, input from developer focus groups, and development prototype models, the team queried how private development is responding to

existing code requirements to better understand the impact of standards and procedures on the overall cost and types of development. This analysis was supported with an in-depth audit of the zoning standards and procedures and multiple rounds of input from a wide range of City staff across different departments. The team also conducted a displacement vulnerability assessment to try to identify the potential impacts that removing regulatory barriers on development may have on fostering gentrification and residential displacement.

This report summarizes these barriers and analyzes how existing zoning standards and procedures may prevent the City of Flagstaff from meeting its goals. The code diagnostic is separated into three sections addressing the:

- Zoning and Subdivision Code (Section 4)
- Building and Fire Code (Section 5)
- Engineering Code (Section 6)

Within each section readers can find a brief summary of the code regulation and why it presents a barrier to meeting housing and/or climate policy goals or, in the case of the building-related codes discussion in Section 5, opportunities are provided to address the City's climate objectives. Tables are provided that capture these findings and rank the magnitude of barriers to meeting key outcomes. A detailed analysis follows pinpointing specific components of regulations and supporting analysis from research and modeling to further explain the nature of the barrier. Where barriers are found, the analysis concludes with a discussion of instances where addressing a barrier would potentially result in co-benefits or generate tensions or trade-offs for both housing and climate goals. Specific alternatives or concepts for how policymakers could reduce or remove identified barriers are not being proposed at this stage. Later phases of the LASS-CAP project will provide a more detailed analysis and summary of suggested code update concepts for zoning and subdivision codes.

1.4 Summary of Findings

Following is a summary of the key barriers identified in Task 3 of the LASS-CAP project grouped by theme.

1.4.1 Zoning and Subdivision Code Barriers

Restrictive regulations on housing types and low maximum density standards in key residential zones are critical barriers to meeting housing and climate goals.

These types of limitations on uses and density primarily are found in Single-Family Residential (R1), Single-Family Residential Neighborhood (R1N), and Medium Density Residential (MR) zones. These regulations are particularly impactful in the R1 zone (including land currently zoned RR or ER that could be rezoned to R1) given that this zone is likely to account for a significant share of new housing development in the future. The Medium Density Residential (MR) zone allows for a variety of housing types and higher density levels than the R1 zone. However, the maximum density of the MR zone remains too low to encourage development of smaller dwelling units, which limits the potential for this zone to contribute to the City's housing and climate goals. Key residential zones in Flagstaff encourage large and expensive homes and

make it more challenging to develop smaller, more affordable types of housing. They also constrain overall housing supply, perpetuate social equity issues such as economic stratification and displacement, and encourage less energy efficient homes and inefficient use of land and infrastructure, and are not supporting viable transit service given lower densities.

Limitations on density and residential uses in commercial zones are a critical barrier to creating housing opportunities in advantageous locations

According to recent building permit data, approximately 28% of multi-family housing in the City has been built in commercial zones. These zones are a critical tool to meet the demand for higher-density housing that provides lower cost housing options, higher density levels to support transit use, and more efficient development patterns to support efficient infrastructure. Residential and mixed-use development is allowed in the commercial zones. However, density is limited to 29 units per acre or less in these zones unless the project is granted a Conditional Use Permit (CUP), which is only an option if the property is within an activity center. This low maximum density is a critical barrier to lower cost market rate housing and encourages inefficient use of land. A CUP is also required to construct a standalone residential use, which may not be the most effective approach for balancing the desire for both residential and commercial uses in these zones.

High parking requirements for housing in transit-served areas is inconsistent with the City's climate goals and increases the development costs for more affordable high-density housing

Minimum parking requirements at or above two spaces per unit, especially in higher density residential and commercial zones, contradicts the City's housing and climate goals. Parking requirements for commercial space in a mixed-use development compound this challenge. To provide the required the minimum amount of parking on-site, projects must either use extensive surface parking, resulting in an inefficient site design, or use structured parking, which dramatically increases project costs. This increase in costs is transferred to the rental price and impacts the end user. More frequently projects may be deemed infeasible and not constructed or designed at lower density levels. This represents a loss of potential housing units foregone due to parking requirements. Oversupplying parking can also contribute to urban heat island impacts, via large surface lots, and higher greenhouse gas emissions, via carbon-intensive concrete needed for parking structures. Current parking minimums encourage high vehicle ownership and preclude more compact development patterns.

High Occupancy Housing development standards and associated review processes add complexity and cost to market rate housing.

The High Occupancy Housing (HOH) regulations that were adopted in 2021 are wide-ranging and have a significant impact on the review process and standards that apply to many higher-density housing projects. The low threshold for HOH requirements and a CUP in commercial zones (any project over 29 units per acre) is a critical barrier to meeting housing and climate goals due to the direct costs and opportunity costs associated with extended review timelines, uncertain conditions of approval, and risk of denial. The HOH standards also add unnecessary complexity to project design, raise equity and Fair Housing concerns, and dilute the effectiveness of the Affordable Housing and Sustainable Residential Building Incentives.

The Resource Protection Overlay Zone requires a large share of natural resources be preserved on a site-by-site basis which constrains housing production and encourages an inefficient use of land without necessarily providing the best protection for resources

The Resource Protection Overlay (RPO) seeks to preserve, manage, and mitigate defined natural resources (including floodplains, steep slopes, and forest). The RPO requires a large share of the resources on each site to be preserved, which constrains housing production and may have unintended consequences such as consuming more land and natural resources on a regional scale and placing more housing units at risk of wildfire hazards. The RPO also more strictly limits density which is not an effective tool for preserving resources.

Affordable Housing and Sustainable Building Incentives are not calibrated to be attractive to private for-profit developers and are undermined by other code standards.

The Affordable Housing Incentives encourage the production of affordable units by allowing increased densities and other incentives for developments that guarantee that a portion of the housing will be affordable. However, the financial benefit of using the incentives is unlikely to outweigh the costs of dedicating affordable units. This is due to decreased revenue from affordable units, a relatively low net gain of market rate units, and using the density bonus may require switching to higher-cost construction types. The incentives are less attractive than alternative pathways to achieving similar benefits that are offered by the code, including the Planned Residential Development (PRD) option, Residential Sustainable Building Incentives, parking reductions, and HOH conditional use permit.

The Residential Sustainable Building Incentives are a rarely used tool in the city's toolbox to encourage developers to construct energy and resource-efficient residential buildings. Projects applying for the bonus must meet the requirements for inclusion of sustainability features in four categories. However, the 25% density bonus may not reach a "tipping point" where the financial benefits of using the incentive outweigh the cost of compliance. This is because the bonus density may not be achievable due to other standards in the code, using the density bonus may require switching to higher-cost construction types, and the HOH CUP offers an alternative pathway to increased density in the commercial zones that may be more attractive than the density bonus.

Requiring a Development Agreement for most rezoning applications unnecessarily complicates the development process and limits flexibility.

Conditioning the approval of the zoning map amendment on approval of a Development Agreement (DA) requires the developer to make specific commitments to a certain development plan. While there are real benefits to the City to be able to negotiate community benefits and DAs are a useful tool to manage complex development, there are many situations where a DA would present unnecessary barriers to housing production and an increase in housing costs. It may also represent an opportunity cost if developers choose to develop at lower densities permitted under the current zoning.

The subdivision review process is unnecessarily complex and all subdivisions are subject to discretionary approval by City Council, slowing the pace of housing production.

Development projects that involve larger parcels of land, multiple uses, and more complex planning issues such as roads, utilities, or natural resources typically require a subdivision application. Title 11 requires a three-phase review process for subdivisions: Conceptual Plat, Preliminary Plat, and Final Plat. The City's requirement for a Conceptual Plat approval prior to submission of a Preliminary Plat is a step in the process that may be unnecessary and adds complexity and cost to the development process. City Council is the approval body for all subdivision applications, regardless of the scale or phase of the application. City Council approval may add unnecessary cost and delay for Preliminary Plat approvals or for all approvals for smaller subdivisions and condominium plats.

1.4.2 Building and Fire Code Barriers

The consultant team conducted an extensive analysis of the City's locally adopted building and fire codes to attempt to identify any specific code barriers to furthering the City's housing and climate-related policies. This analysis included discussions with developer stakeholders and City staff, a review of development case studies at the City, living unit energy and water modeling, and extensive review of the International Building Code (IBC), International Fire Code (IFC), and supplemental City-specific standards. This analysis generally found that, because many of the building and fire code standards are state and federally mandated, there are relatively few barriers that that the City has the ability to alter. Therefore, as described in Section 5 of this report, the consultant team has focused on opportunities for optional requirements and incentives that could be adopted to attempt to improve outcomes for housing affordability and for climate. These opportunities include the following actions that the City could consider:

- Require building permit applicants to submit a Zero Code Tool report that provides an estimate of annualized energy use in the building and renewable energy potential with the design.

- Adoption of the 2021 International Energy Conservation Code (IECC) or, at a minimum, strengthen energy performance in specific areas related to air tightness, lighting and lamp efficiency, ventilation recovery, water conservation and appliance efficiency.

- Expansion of solar-ready requirements.

- Expansion of electric vehicle (EV)-ready outlets for multi-family housing projects.

- Adoption of point access block or single stair exiting allowance to allow for more efficient multi-family development design and cost reduction.

- Consider allowance of 6-inch water main extensions for new development (rather than 8-inch mains per engineering standards) when adequate fire flows can be demonstrated.

- Provide greater opportunity for site specific deviations from explicit aerial apparatus accommodation standards after review and approval from building and fire code officials when sufficient alternatives can be demonstrated.

Further discussion of the benefits of these recommendations and other potential opportunities are discussed in greater detail in Section 5 of this report.

1.4.3 Engineering Code Barriers

Section 6 of this report includes an extensive analysis of aspects of the City's code provisions including the City's transportation and transportation impact analysis (TIA) requirements as they relate to the City's housing production and climate objectives. This analysis involved development stakeholder meetings, meetings with City staff, a review of development case studies, and an extensive review of Title 8, Title 13, the TIA Manual, and the City's Stormwater Manual and Low Impact Development guidelines. Detailed findings are included in Section 6 of the report. The following high-level findings summarize potential barriers and possible code update considerations for the City:

- City collector and arterial street standards are based on traffic volumes and design speeds that may be excessive, offering an opportunity to potentially reduce total facility designs, thereby reducing land consumption and roadway construction costs and resulting in a road cross section that promotes sustainable modes of transportation.

- Provide greater allowance for reduction of local street standards to limit the widths to the minimum necessary for fire access.

- Review and consider changes to the City's Winter Parking Ordinance that restricts overnight on-street parking, rendering more expansive streets unusable for much of the year.

- Greater restriction on the allowance for cul-de-sacs and dead-end streets to promote walkability and transportation network connectivity.

- Establish a transportation impact fee system that would create greater development cost predictability and greater equity in the distribution of transportation network investments.

- Incorporate trip reduction plan allowances into the TIA manual that would allow for TIAs to demonstrate reduced vehicular trip generation through the provision of the following facilities and/or programs that could include:

    - Carpool or vanpool matching services

    - Rideshare, carshare, or bikeshare programs

    - Free or discounted transit passes

    - Establishment of a commute management program

    - Multi-modal infrastructure (transit shelters, bike/pedestrian paths, wayfinding, etc.)

    - Commuter facilities (showers, lockers, etc.)

    - Real time transit and/or transportation information displays

    - Telecommuting or work shift change commitments.

- Review and consider the current accuracy of water flow rate assumptions in Tables 13-09-002-01 and 13-09-003-02 as these flow rates are from 1980 and may be more conservative (assume greater flow rates) than currently experienced. Such changes could result in the demonstration of reduced water demand and result in reduced infrastructure and connection fee costs to new development.

Section 6 discusses these recommendations and others in substantial detail.

1.5 Future Phases of Work

Future phases of the LASS-CAP project will build off this code diagnostic to begin to examine and evaluate potential code updates to reduce or remove identified barriers within the current structure of Arizona law. This will include research into innovative and effective best practices from other jurisdictions related to housing affordability and carbon neutrality and development of a range of conceptual code updates. Code concepts will be quantitively evaluated using development prototype models. In the final phase of the LASS-CAP project the team will refine code concepts into more detailed, actionable recommendations for either specific changes or further evaluation for the zoning and subdivision code barriers identified in this report and will incorporate recommendations from Sections 5 and 6 of this document. In addition, an on-going analysis to address specific barriers and recommendations for better transit accommodation with development will be incorporated into the final Code Recommendations and Impact Report.

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT– DEVELOPMENT CODE DIAGNOSIS

PROJECT BACKGROUND

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2.0 PROJECT BACKGROUND

2.1 Purpose of this Report

With the adoption of its 10-Year Housing Plan and Carbon Neutrality Plan, the City of Flagstaff has established a bold vision of providing housing that is broadly affordable while at the same time achieving carbon neutrality by 2030. The City's development code, building regulations, engineering standards, transportation policies, and funding mechanisms are the tools to support and implement these broader housing and climate goals. This report provides a detailed analysis of these codes to determine the ways in which they do or do not support the City's vision. This is the first phase of a project aimed at developing recommendations for proposed improvements to the code to better support housing and climate goals.

The consulting team reviewed all relevant goals, policies, and plans related to the declared housing and climate emergencies. These planning and policy documents are detailed in Section 2.1 of this report. Given the comprehensive nature of this project, relevant goals, policies, and plans were summarized into a set of policy outcomes. The function of these outcomes is twofold. First, it serves as an inventory to identify all relevant goals, plans, and policies across multiple agencies and topic areas to ensure a thorough and holistic review of the codes. Second, it is a tool to establish clear links between adopted policy goals and the code provisions that are barriers to meeting these goals.

This report highlights key barriers in the code to achieving the City of Flagstaff's housing and climate goals. Each barrier is identified followed by a discussion that identifies the ways certain standards or policies affect the desired policy outcomes. Concepts for how policymakers could reduce or remove identified barriers will be addressed in future phases of this project. Specific alternatives are not being proposed at this stage.

2.2 Planning Context

2.2.1 Housing Emergency

On December 1, 2020, City Council declared a Housing Emergency, committing to prioritizing affordable housing within City operations to create safe, decent, and affordable housing opportunities for all community members. To formalize this commitment and operationalize it, the City adopted a 10-Year Housing Plan. The plan defines the housing emergency and identifies policy initiatives and strategies to address the housing emergency.

The overall goal of the 10-Year Housing Plan is to increase the number of available and attainable housing options at all income levels [1]. Success will be measured against whether or not the City is able to reduce the current housing need in the community by half over the next ten years. This will include:

- Impacting at least 6,000 low-to-moderate income residents through unit creation and subsidy provision.

[1] City of Flagstaff, Arizona. 10-Year Housing Plan.

- Creating or preserving 7,976 housing units to increase the overall supply of market rate, workforce, and affordable housing.

This is a bold vision given the current housing challenges faced by the community. The 10-Year Housing Plan found that 27% of homeowners and 57% of renters are housing cost burdened, meaning they spend more than 30% of their monthly income on housing costs. The median sales price of a home rose by 119% between 2011 and 2021, while the Area Median Income rose by only 16%. Yet, Flagstaff is committed to ensuring all members of the community have equitable access to safe, decent, and affordable housing.

2.2.2 Climate Emergency

Prior to adoption of the Housing Emergency, the City initiated a Climate Emergency Declaration in June 2020 confirming a commitment to combat climate change and calling for a dramatic increase in ambition and a city-wide mobilization towards an equitable transition. Flagstaff has seen firsthand the impacts of these changes with increased threat of high-severity wildfires and related post-fire flooding. The Carbon Neutrality Plan established a vision for how Flagstaff can achieve carbon neutrality by 2030.The Carbon Neutrality Plan has three primary goals[2]:

1. Achieve carbon neutrality by 2030 (mitigation), including:
    a. Mitigation target: Reduce community greenhouse gas emissions by 44%, compared to business-as-usual emissions projections.
    b. Carbon dioxide removal (CDR): Balance any remaining greenhouse gas emissions with carbon dioxide removal (equivalent to 471,000 tons).
2. Prepare Flagstaff's communities, systems, and resources to be more resilient to climate change impacts (adaptation).
3. Address climate change in a manner that prioritizes those most impacted and ensures the costs and benefits of climate adaptation and mitigation are equitably distributed (equity).

Appendix A of the Carbon Neutrality Plan provides actions that were used to arrive at the carbon neutrality calculations, which resulted in the following key shifts needed to reach the Carbon Neutrality[3]:

- Significant reductions in the miles we travel by passenger vehicles
- Rapid solar energy development
- Extensive building retrofits and electrification
- Municipal renewable energy and energy use
- Low-impact new buildings
- Carbon dioxide (CO_2) removal

The Plan identifies fifteen target areas to meet mitigation, adaptation, and equity goals. The plan highlights ambitious actions that address climate concerns and will have co-benefits for housing

[2] City of Flagstaff, Arizona. A Bold Vision: Flagstaff Carbon Neutrality Plan Summary. 2021.

[3] City of Flagstaff, Arizona. A Bold Vision: Flagstaff Carbon Neutrality Plan. Appendix A. 2021.

and transportation systems and prepare Flagstaff to be more resilient in the face of climate change impacts. A key lens for climate goals was equity and the disproportionate impact of climate change that affects older adults, people of color, and low-income neighborhoods.

2.2.3 Regional Plan 2045

The Flagstaff Regional Plan is a policy guide that serves as the general plan for the City of Flagstaff capturing the community's vision for future growth. Arizona state law requires cities to update or re-adopt a general plan every 10 years by a public vote. The current Flagstaff Regional Plan was adopted in 2014 and, therefore, must be readopted or updated in 2025. The current plan was adopted by both the City and Coconino County, and covers the larger Flagstaff metro area, including the entire City of Flagstaff boundaries. The City of Flagstaff and Coconino County are currently in the process of a full plan update. The Flagstaff Region is changing rapidly, and a reevaluation and calibration of goals and policies is necessary to ensure that Flagstaff continues to grow in a sustainable and equitable way. The Regional Plan will reflect the Housing and Climate Emergencies and discuss the intersections and tensions between housing, climate, land use and development, natural resources, and transportation.

The Regional Plan will define a specific form of future growth and formulate specific policies to achieve goals in each topic area. The updated Regional Plan will translate priorities into a future growth/land use map. The Flagstaff Zoning Code is one of the primary tools used to achieve the growth scenarios as represented in this growth/land use map. For example, areas identified for increased residential development in the Regional Plan Map will need to be supported with corresponding zone changes that permit the types of housing to meet projected growth targets. These initial growth scenarios were another element used to evaluate existing zoning districts and regulations to ensure the vision for growth and land use can be achieved.

2.3 State Law

Arizona state law constrains how municipalities, including Flagstaff, can regulate land use and development. The extent to which Flagstaff can use zoning as a tool to meet its housing and climate goals is limited to some extent by certain state provisions. These are summarized below. These limitations were considered in auditing the City's codes.

2.3.1 Proposition 207

The Private Property Rights Act of 2006, also known as Proposition 207, allows for private property owners to seek compensation if the value of the owner's property is reduced by the enactment of a land use law. A land use law regulates the use or division of land. Municipal codes are one such mechanism to regulate the use and division of land. Examples of how zoning can reduce the value of private property include:

- Removing a certain permitted land use from a particular zone
- Reducing the maximum density allowed in a particular zone

- Reducing the maximum allowable building height[4]

Any of these zoning changes could effectively reduce the property value of a private landowner. It is an expensive option for local governments to provide compensation to private property owners to offset this reduction. As a result, local governments have to consider Proposition 207 implications before adopting new rules and may, in many instances, elect to limit amendments that could be subject to Proposition 207 claims.

2.3.2 Additional State Pre-emptions

Several additional state pre-emptions are important to note that impact the possible tools the City of Flagstaff can use to address housing and climate outcomes.

- **Inclusionary Zoning**
  Inclusionary zoning requires housing developers to set aside a certain percentage of housing units to be rented or sold at an affordable price.[5] Many local governments use this tool to provide additional affordable housing supply. Arizona Revised Statutes (ARS) 9-461.16 prohibits local governments from adopting land use regulations, general or specific plan provisions, or conditions for approving a development project that effectively establish the sales or lease price for housing or require housing units or a lot be sold or leased to a particular class or group of residents. This law prevents inclusionary zoning policies.

- **Short Term Rentals and Rent Control**
  Another limitation on tools to address housing concerns is the state preemption on regulating short term rentals. Senate Bill 1350 prohibits cities in Arizona from restricting short term rentals. These second homes rented out may be listed as "vacant" but are not in fact available to renters and therefore do not add to the overall supply needed to meet housing need. This is relevant because in recent years Flagstaff has seen a rapid increase in short-term rentals due to tourism. For example, Sedona (which has a similar tourism market) has seen a rise of short-term rental units from 300 to 1,000 since 2016 – this number of units accounts for 20% of the City's total housing inventory.[6] The State also preempts the power to control rents per ARS 33-1329. This means Flagstaff is not able to use rent caps as a tool to address housing affordability.

- **Impact Fees**
  Some states allow local municipalities to charge impact fees on new private development. The fees are normally charged per square foot on a new commercial or residential development. Revenue collected can be used to fund vital infrastructure upgrades that support new development. Impact fees can also be used to fund housing trusts and can provide vital funding for affordable housing development and restoration. ARS 9-4-6.2.1 controls how local municipalities can charge impact fees and use the revenues collected. Impact fees may only be used to offset costs associated with the

[4] City of Flagstaff, Arizona. High Occupancy Housing Specific Plan, 2018.

[5] Carr, Joanna. Arizona Housing Coalition. Best Practices Toolkit for Municipalities, for Increasing the Supply of Affordable Housing in Arizona.

[6] Carr, Joanna. Arizona Housing Coalition. Best Practices Toolkit for Municipalities, for Increasing the Supply of Affordable Housing in Arizona.

expansion of infrastructure and public services as a result of new development. Any fees must benefit only the specific development and cannot be more broadly applied.

- **Electrical Utilities**
  Flagstaff cannot require new developments to require electrical utilities. ARS 9-810 preempts restrictions or limitations on utility provider's authority to operate. Ordinances or plans cannot call for prohibiting or restricting a person or entity's ability to use the services of authorized utility providers nor can they impose a fine or other requirements that may restrict the provider's ability to operate or serve its customers. This includes utilities such as natural gas or electric service. The City of Flagstaff therefore cannot require all electrical development as a means to meet its stated carbon neutrality goals.

However, local governments can use incentives, density bonuses, or other voluntary provisions or conditions to increase the supply of low cost or affordable housing or the use of more climate neutral utilities.[7]

2.4 Methodology

The Consultant Team evaluated the City's development codes and processes using the key outcomes, described in Section 3, as a comprehensive framework for all the City's policy goals related to housing and climate. We assessed all sections of FCC Title 4, 5, 8, 10, 11, and 13 to identify regulations that pose a barrier to achieving these goals. This report summarizes these barriers and provides an analysis of how they prevent the City of Flagstaff from meeting its goals.

In order to deepen our understanding of the specific impacts of the code and potential barriers to policy goals, the Consultant Team used several technical analyses. These analyses are reflected in our discussion of barriers in Section 4 of this report. A summary of these analyses is provided below.

2.4.1 Project Case Studies and Developer Focus Groups

Recent development projects provide case studies of how private developers are responding to existing code requirements. The City provided application materials and relevant background information on recently built and proposed projects. The Consulting Team also toured recently constructed projects during a site visit and conducted two developer focus groups.

We reviewed projects to better understand the impact of current standards and procedures on the overall cost of development (including pre-development, design and construction) and potential impact on affordability of projects; the type, density, size, and other characteristics of housing constructed; the location of the project and associated climate outcomes due to the accessibility of the project by walking, biking, or transit; the design of the building and the degree to which current sustainability or affordability incentives were used; and the design of public improvements required of the project and how well those improvements support walking, biking, and transit.

[7] ARS 9-461.16 Residential housing; requirements; fees; prohibition.

2.4.2 Development Prototype Models

The Consulting Team developed physical and financial models of hypothetical developments to more precisely evaluate the impacts of the code on housing and climate outcomes. These prototypical examples of development projects — or prototypes — demonstrate what is likely to occur within a given set of code parameters. A range of prototypes were developed to account for variations in regulations across all zoning districts that permit residential uses (R1, R1N, MR, High Density Residential (HR), Suburban Commercial (SC), Community Commercial (CC), Neighborhood Community Commercial (NCC), Highway Commercial (HC), Commercial Service (CS), and Central Business (CB)). Prototypes include two components:

- **3D Model** that is a scaled representation of the basic elements of development, including the building, parking areas, setbacks, and open space. The purpose of the 3D model is to test the physical feasibility of meeting code standards and evaluate the impact of code standards on the physical form of development.

- **Financial Pro-Forma Model** that accompanies the 3D model that estimates the return-on-investment of the project given a set of inputs, including the physical development program and financial inputs of costs and revenues based on the local market. The purpose of this financial model is to test the economic feasibility of a potential project by determining the minimum sale price or rent rate needed to meet a target level of profitability or the maximum cost of land acquisition to meet a target level of profitability. Costs of development include soft costs (professional services, fees, etc.), infrastructure, site development, and hard costs associated with building construction. Using this information, the pro-forma model estimates the minimum income needed to afford a housing unit in that model. Affordability is defined as spending no more than 30% of income on total housing costs, including not only rent or mortgage but also utilities, insurance, and property taxes. Utility costs and property taxes reflect local costs in Flagstaff, including energy costs, which vary significantly by unit size and type.

Key findings of the prototype modeling are incorporated into this Code Diagnosis. The full results of the prototype modeling and more information on the methodology and inputs are documented in Appendix 4.1 of this report.

2.4.3 Displacement Vulnerability Assessment

The removal of regulatory barriers on development, in some locations and contexts, can have the unintended consequence of accelerating pre-existing processes of gentrification and residential displacement. Displacement can either be physical (when existing residents are forced to move when property is renovated, redeveloped, or converted to a new use) or economic (when market conditions cause rents or property taxes to increase to unaffordable levels for existing residents). When displacement is associated with a broader pattern of demographic and housing market changes across a neighborhood, this is known as gentrification.

It is worth noting that in addition to the effect of market pressures on the supply and demand for housing, Flagstaff anticipates additional pressure on the housing market stemming from climate change. Flagstaff has already seen an increase in extreme weather including drought, wildfire, flooding, extreme heat, and wind events. These events are only expected to increase in intensity and impacting specific areas within the City's boundaries. These changes may displace existing residents more vulnerable to extreme events. Likewise, as extreme weather events

continue to impact the larger region, it is likely that Flagstaff will also see an increase in population displaced from hotter regions within the state. These movements of populations will have very real implications for the future housing supply and demand but are not captured in this Displacement Assessment, which focused on understanding the relative vulnerability of individual neighborhoods within Flagstaff to displacement pressures.

The City does not currently have a comprehensive, data-driven analysis that identifies the neighborhoods within the City where new development could potentially contribute to appreciating prices/rents and accelerate economic displacement. Building on academic research methods, Cascadia Partners conducted a spatial analysis identifying areas at risk of future gentrification and displacement pressure. This spatial model is based on census tracts and data available from the federal government. The model consists of two primary components:

- An index of **Displacement Vulnerability** was developed using a set of demographic indicators, including education, income, housing tenure, and race and ethnicity. Taken together, they represent a measurement of how vulnerable residents are to displacement arising from increasing housing costs brought on by gentrification.

- An analysis of **Demographic and Housing Market Change** identified if housing market pressures are increasing and demographics are changing in neighborhoods, including changes in education, income, housing tenure, and race and ethnicity. Census tracts experiencing higher than average rates of demographic and market change are indicative of areas potentially experiencing gentrification and displacement.

Taken together, these two components were used to classify each neighborhood into a typology based on vulnerability and stage of gentrification. Key findings of the displacement vulnerability assessment are incorporated into this Code Diagnosis. The full results of the analysis and more information on the methodology are documented in Appendix 4.2.

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT–
DEVELOPMENT CODE DIAGNOSIS

POLICY GOALS AND KEY OUTCOMES

3

3.0 POLICY GOALS AND KEY OUTCOMES

3.1 Planning Documents

After carefully reviewing the policy matrix previously described, the consultant team studied all relevant planning documents. These included plans and policies related to housing, climate, and transportation. All goals and policies related to transit-associated emergency declarations, Mountain Line's Flagstaff in Motion Community Transit Plan, or other planning documents (such as Mountain Line's Transit Planning Guidelines and the City's Active Transportation Master Plan, or ATMP) were carefully reviewed as well.

Other relevant planning and policy documents reviewed include the Northern Arizona University (NAU) Campus Master Plan, Flagstaff's Lived Black Experience Strategic Plan, Best Practice Toolkit for Municipalities for Increasing the Supply of Affordable Housing in Arizona, Downtown Flagstaff Vision and Action Plan, City of Flagstaff Water Conservation Strategic Plan, City of Flagstaff Incentive Policy for Affordable Housing, and the High Occupancy Housing Specific Plan.

3.2 Translating Policy Goals to Key Outcomes

The City has adopted multiple plans and policy documents that establish the City's formal goals related to housing and climate change. Each of these planning documents includes multiple goals that are relevant to these two broad issues. Some of these policy goals articulate closely related concepts but may use slightly different language across different planning documents. In other cases, the policy goals may be expressed in more general terms in one document but are articulated in more detailed terms in another document. In some documents, the goals are expressed as end results and in others they are expressed as strategies or tactics for achieving end results.

This variation in language and specificity across plans means that it can be difficult to establish a clear and well-defined set of policy goals that should be used to evaluate development regulations. If this analysis were to use specific terms from one planning document, it risks privileging the specific way in which that goal was articulated in one plan over other plans, despite the fact that all of these plans were formally adopted by the City as guiding policy documents. Additionally, the specific terms used in one plan may not express other dimensions of the policy goal that are articulated in other plans.

3.2.1 Outcomes vs. Goals or Strategies

To address these issues, the consultant team collaborated with City staff to translate and distill the policy goal language from the planning documents into an integrated set of outcomes. The concepts are expressed as outcomes to distinguish them from goals or strategies. Goals articulate the achievement of a specific measured outcome or milestone (such as number of housing units or greenhouse gas emissions reductions). These are useful benchmarks, but they can be impractical to use to evaluate development regulations, which apply on a site-by-site basis. Some citywide modeling will be conducted to assess the potential impact of recommended code changes on meeting these citywide goals, but that modeling is not useful to

conduct until the City has come to consensus on a set of code changes that may be supported for adoption.

The planning documents also identify strategies, which are specific methods for achieving goals. Strategies are useful for identifying how the codes may be amended to move toward achieving goals. However, the strategies identified in the planning documents may not be the only method for achieving the City's goals or the most effective method. Therefore, for the purpose of analyzing the code, it is more useful to focus on the outcomes that the City hopes to achieve, leaving open the possibility for a wide variety of strategies or approaches.

3.2.2 Key Housing and Climate Outcomes

Tables 1 and 2 provide the list of key outcomes that were derived from the planning documents related to housing and climate change, respectively. The tables identify and define the desired outcome, then provide examples of specific policy goals or strategies that articulate that outcome in the planning document. The outcomes express related concepts, but are specifically structured to refer to distinct outcomes which could occur independently of each other, even if they may often correlate.

The intent of the outcomes is to provide a clear and integrated framework that can be used to evaluate the City's various codes in a comprehensive and consistent manner. Each time a code regulation is identified as a potential barrier or issue, this analysis will identify which specific outcomes are impacted by that code regulation. This approach ensures a holistic evaluation in which all relevant outcomes are considered for each regulation. This also enables the City to identify when a desired outcome is affected by multiple, separate code regulations, which may have a compounding effect on the ability of the City to achieve that outcome.

Table 1. Key Housing Outcomes

Housing Outcome	Description
Abundant Housing Supply	Flagstaff supports an abundant supply of housing of all types and incomes levels to meet the needs of existing and future residents.
Diversity of Housing Types	Flagstaff produces a diversity of housing types (detached, attached, unit sizes, ownership types, density levels, etc.) to meet the needs of all segments of the population.
Lower Cost Market Rate Housing Production	Flagstaff produces sufficient market rate housing that could be affordable to households with lower or moderate incomes. This housing is lower cost by virtue of its design, size, or other features. It is not restricted to be affordable to households of certain income levels and does not receive public subsidy.
Income-Restricted Affordable Housing Production	Flagstaff produces sufficient housing that is restricted in price or rent level to be affordable to households with lower or moderate incomes. This housing may be constructed by the private or public sector and usually receives some form of public subsidy or incentive.
Mixed Use Development and Neighborhoods	Flagstaff produces sufficient housing that is in close proximity, ideally a walkable distance, to commercial uses that support daily needs of residents. The housing may be on the same property or building as the supportive commercial uses (mixed use development) or may be on other properties in the neighborhood.
Infill Development and Compact Land Use Patterns	Flagstaff supports flexibility and appropriate density in residential neighborhoods to provide more diverse and attainable housing opportunities, encourages housing that uses land efficiently and is sited in locations with existing infrastructure and amenities. This infill development can reduce pressure to expand development outward into rural or natural areas.
Equity and Fair Housing	Flagstaff encourages housing and development that reduces inequities in access to housing and neighborhoods, and works to address disparate impact as part of any development or redevelopment. These inequities could include the inability to afford housing in certain neighborhoods, the inability to afford to continue to live in one's current neighborhood, or the inability to afford any housing at all.

Table 2. Key Climate Outcomes

Climate Outcome	Description
Community Resilience, Health and Safety	Flagstaff will increase its ability to anticipate, positively adapt to, and thrive amidst changing climate conditions and hazard events while enhancing quality of life, reliable systems, economic vitality, and conservation of resources. Strategies may include encouraging the adaptive reuse of existing buildings, and the preservation of appropriate existing buildings to reduce the carbon emissions associated with construction. Flagstaff will create a resilient community by ensuring abundant and equitable access to health services, recreational opportunities, parks, and open spaces, such as through 10-minute park access and developing a strategy to better support the ongoing maintenance of sidewalks, Flagstaff Urban Trails System (FUTS) trails, and other non-vehicular access routes.
Sustainable Transportation Networks and Neighborhoods	Flagstaff creates vibrant neighborhoods that decrease travel distances. This could include lowering or eliminating parking minimums, allowing for more variety of housing types in existing neighborhoods, reducing impervious surfaces, and promoting decoupling rent from parking costs, among other factors. Flagstaff's development patterns support networks for walking and biking that are continuous, attractive, safe, comprehensive, and convenient. This could include adoption of a Complete Streets policy; conversion of appropriate streets to multi-modal and complete streets; construction of new bike and pedestrian infrastructure; an integrated system of trails and protected lands; and sufficient maintenance and snow removal; among other factors. Flagstaff supports development patterns that encourage transit ridership and transit efficiency. This may include the design of street networks, signal prioritization, the provision of transit facilities, the provision of transit facilities and "transit priority measures". This could be bus only lanes, transit signal priority, the distribution of density and overall density levels, mixed-use transit nodes, and incorporating transit needs and requests into the transportation analysis for new developments, among other factors.
Electric Mobility	Flagstaff will welcome and support electric micro-mobility (including e-bicycles, scooters, hoverboards, and other small, low-speed electric transportation devices), shared vehicles, and electric vehicles. Strategies may include planning the installation of electric micromobility hubs, Level II and Level III DC fast-charging electric vehicle (EV) charging stations throughout Flagstaff, and incentivizing multifamily housing to offer EV charging stations and shared electric micromobility devices.
Energy	Flagstaff will support renewable electricity production and installations within City limits, and will significantly reduce greenhouse gas emissions from heating, cooling, and powering buildings. Flagstaff will encourage energy efficiency by progressively implementing progressively more aggressive building codes, such as requiring net zero energy buildings by 2030, and ensuring the City's building code is reflective of rapidly changing technology related to energy efficiency, renewable

Climate Outcome	Description
	energy, energy or battery storage, and electrification. Flagstaff will shift its building fuel sources from fossil fuels to renewable sources and electricity for applications including space and water heating, cooking, and perhaps even industrial processes, taking advantage of the superior efficiency of electric appliances.
Waste and Water	Flagstaff will move towards sustainable consumption, diverting more organic and recyclable materials from the landfill, and reducing emissions from the landfill. Strategies include reducing construction and demolition waste, volumetric pricing, expanding compost services, etc. Flagstaff will increase water efficiency and conservation at the consumer level, and reduce emissions from water and wastewater treatment. Strategies may include building code changes, maximizing groundwater recharge, updating landscape and stormwater codes to accommodate projected climate changes, and supporting green infrastructure.
Healthy Forests and Carbon Dioxide Removal	Flagstaff will support thriving local ecosystems that are resilient to climate change, publicly accessible, and store and remove carbon dioxide from the atmosphere. Flagstaff will protect appropriate natural resources by reducing urban encroachment into the forest and wildland-urban interface (WUI), encouraging infill development, creating fire-wise and fire-adapted neighborhoods, supporting the restoration-based forest product industry, and planning for plant and landscape transitions. Flagstaff will develop carbon dioxide removal initiatives to meet Flagstaff's commitment to carbon neutrality, which may include smaller-scale regenerative agriculture, meadows, and forests as sequestration sinks, among other factors.

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT– DEVELOPMENT CODE DIAGNOSIS

ZONING & SUBDIVISION CODE ANALYSIS

4

4.0 Zoning and Subdivision Code Analysis Overview

This section of the report provides in-depth analysis of the code regulations from Title 10 (Zoning) and Title 11 (Subdivision) that were found to be a barrier to meeting the policy goals described in Section 3 of the report. The following information is presented for each code barrier.

- **Summary:** A brief summary of the code regulation and why it presents a barrier to meeting housing and/or climate policy goals.
- **Code Reference:** Identifies all relevant sections in the Title that include regulations that were found to be barriers to meeting policy goals.
- **Impact on Key Outcomes:** A table is provided that identifies the specific key outcomes that are impacted by the code regulation. The magnitude of the barrier to meeting the key outcomes is assessed by assigning one of three tiers to each key outcome.
    - *Critical Barrier:* Code provisions that *render it physically or economically infeasible* to develop a project that contributes to the City's housing and/or climate goals. These code provisions generally are barriers independent of other standards or requirements and apply broadly to many types of developments or locations.
    - *Major Barrier:* Code provisions that *significantly reduce the feasibility* of developing a project that contributes to the City's housing and climate goals. The degree to which these provisions are barriers may be contingent on other standards or requirements and the barrier may apply to a narrower range of development types of locations.
    - *Minor Barrier:* Code provisions that *may have a limited negative impact on the feasibility* of developing a project that contributes to the City's housing and climate goals. The degree to which these provisions are barriers may be contingent on other standards or requirements and the barrier may apply to a narrower range of development types of locations.
- **Analysis of Issues and Impacts:** A detailed analysis that identifies the specific components of the regulation that present a barrier and presents evidence of that barrier from the research and modeling conducted for this project.
- **Co-Benefits of Addressing the Barrier:** Where relevant, if reducing or removing a barrier would have co-benefits of synergistic impacts on both housing and climate goals, these areas are identified. See discussion and co-benefits identified below.
- **Tensions with Other Policy Goals:** Additionally, if addressing the barrier would potentially generate tensions or trade-offs between policy goals, the team identified and discussed these. See discussion and tensions identified below.

By including all of the above information for each code barrier, the City will be able to make more informed decisions about which barriers are most important to address. The team will determine and discuss alternative regulations or standards that are feasible for the City to implement in the next phase of work for this project.

4.1 Single-Family Residential (R1) and Single-Family Residential Neighborhood (R1N) Zone Districts

4.1.1 Summary

Restrictions on the types of residential uses permitted, low maximum density standards, and high minimum lot size standards in the Single-Family Residential (R1) zone district present barriers to achieving desired housing and climate outcomes. The R1 zone restricts development to a very limited range of housing types, caps maximum density at 6 units per acre, and requires lots to be at least 6,000 square feet. These standards encourage large and expensive homes and make it more challenging to develop smaller, more affordable types of housing. This promotes a less efficient land use pattern that does not advance climate goals.

4.1.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🔵	Community Resilience, Health and Safety
🔴	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🔴	Lower Cost Market Rate Housing	🔵	Electric Mobility
🔵	Income-Restricted Affordable Housing	🟠	Energy
🟠	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🔴	Infill Development and Compact Land Use	🟠	Healthy Forests and Carbon Dioxide Removal
🟠	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.1.3 Code Section(s)

- Residential Zones - R1: 10-40.30.030.A.3
- Residential Zones - Allowed Uses Table: 10-40.30.030.B.
- Residential Zones - Building Form and Property Development Standards Table: 10.40.30.030.C.
- 10-40.60.280 Planned Residential Development, amended

4.1.4 Analysis of Issues and Impacts

The R1 Single-Family Residential Zone allows a detached single-family dwelling or an attached single-family dwelling, plus one accessory dwelling unit (ADU) per lot. Additional housing types may be allowed but are subject to restrictive limitations. A duplex is permitted on lots with significant natural resources within the Resource Protection Overlay (RPO) or as part of an affordable housing development. A multi-family dwelling is permitted under the same criteria; however, no more than two units may be attached and contained in one building. In other words, multiple dwellings may be located on the same lot but must be divided into single unit detached structures or duplex structures.

Similar limitations also apply to the Rural Residential (RR) and Estate Residential (ER) zone districts. However, those zone districts limit density to 1 unit per acre. At this density level, subdivisions and development with full urban services are usually not cost effective. Therefore, these zones typically function in part as "holding zones" for future rezoning and urbanization at a higher density. However, due to some of the complexities associated with the rezoning process, some subdivisions are being proposed at this low-density level. This issue is discussed in detail in Section 4.9 of this report.

The maximum density of the R1 zone district is 5-6 units per acre and the minimum lot size in the zone is 6,000 square feet. Many properties have been rezoned from RR or ER to R1 in order to build residential subdivisions at density levels that are more cost-effective for the provision of full urban services. Yet, a density of only 5-6 units per acre remains a relatively inefficient use of land and infrastructure; severely constrains the ability to serve areas with transit or provide for walkable commercial uses; encourages developers to build larger and more expensive homes; and limits the overall supply of new housing.

The R1 zone (including land currently zoned RR or ER that could be rezoned to R1) is likely to account for a significant share of new housing development in the future, continuing the historical trend.

Minimum lot size and minimum street width standards present barriers to designing a subdivision at the maximum density allowed in the zone.

It is often not possible for a development to build to the maximum density allowed in the R1 zone due to other regulations that constrain density. The RPO is one such regulation and is addressed in detail in Section 4.9. In addition to the RPO, the minimum lot size and minimum street width required by the code often preclude achieving the maximum density of 5-6 units per acre. The prototype modeling found that, outside of an RPO, it was only possible to build to a density of approximately 4.7 units per acre under the R1 zone standards.

This barrier can be overcome by pursuing the Planned Residential Development (PRD) option, which allows for lots as small as 2,000 square feet. This is a useful option for developers; however, the PRD approval also requires meeting certain design standards and can complicate the proposed development. It would be consistent with the City's housing and climate goals to ensure the maximum density of the zone can be achieved under the base development standards.

Low density development patterns in urban areas are inconsistent with the City's climate goals.

The R1 zone is intended to allow for residential developments at a minimum density of 2 units per acre and a maximum density of 5-6 units per acre. This density level, developed broadly throughout the City, is inconsistent with the City's climate goals. This relatively low-density pattern raises the following challenges for meeting these climate outcomes:

- **Encourages larger, detached homes, which are less energy efficient.** The draft Regional Plan 2045 Regional Snapshot on Climate Change and Energy highlights that 51% of Flagstaff's emissions are from building energy, 19% of which is from residential buildings. By limiting the economic incentive to build smaller or attached units, the low density in the R1 zone results in larger, detached homes. These homes require more energy to heat and cool than smaller homes and attached homes, which is shown in the prototype model below.

- **Uses land and infrastructure inefficiently and may lead to more development in sensitive natural landscapes and fire-prone areas.** The low-density development pattern supported by the R1 zone results in an inefficient use of land and infrastructure. Urban-scale infrastructure is needed to serve this density, but the cost to serve each unit is relatively high. For example, infrastructure and utility costs for the R1 zone prototype model are around $92,000 per unit and that number decreases as you increase density. That cost is much lower per unit in the MR Zone prototype model (3-Story Apartments) which is about $33,000 per unit and the HR zone prototype model which is about $15,000 per unit. As fewer units are provided with each new development, this low-density development pattern may contribute to displacing more development to the periphery of the city, which impacts natural areas and places more residents in fire-prone locations.

- **Limits the economic viability of transit services and walkable neighborhood commercial uses.** Transit services are more challenging to provide, and in some cases economically infeasible, in places with low density development patterns. Research suggests that the minimum density required for efficient bus service is at least 8 dwelling units per gross acre, and at least 10-15 units per acre is ideal[8]. Similar density levels have been found to make neighborhood-serving commercial uses economically viable[9]. Consequently, development patterns below this density level will foster greater automobile-dependency and increase the distance required to travel between activities, leading to ever increasing vehicle miles traveled (VMT). Higher VMT increases the cost of living, reduces quality of life and health outcomes, and moves Flagstaff further from its climate goals.

[8] Source: Transit-Supportive Densities and Land Uses: A PSRC Guidance Paper (February 2015)

[9] Source: Residential Density and 20-Minute Neighborhoods: A Multi-Neighborhood Destination Location Optimisation Approach.

Restrictive use regulations and low maximum density discourage lower cost, "missing middle" housing types.

The residential pattern of low density, primarily single-family homes that is encouraged by the R1 zone is inconsistent with the City's goals to encourage lower cost market rate housing. The prototype modeling conducted for the R1 zone found that the minimum feasible sale price for a unit in this zone is approximately $940,000 (Figure 1) for a 2,000 square-foot home on a 6,000 square-foot lot, while the minimum rent is $6,100 per month. A household would need to earn at least 274% of the Area Median Income (AMI) in Flagstaff to afford to buy this home, and at least 240% of the AMI to afford to rent.

A key driver of this high price is the assumed unit size of 2,000 square feet. The low-density level allowed by the R1 zone discourages developers from providing smaller unit sizes because reducing unit sizes would not enable the project to include more units. At a low-density level of 6 units per acre, it is almost always more profitable to construct larger homes than smaller homes. If higher densities were permitted, then developers may be encouraged to construct smaller, more affordable homes.

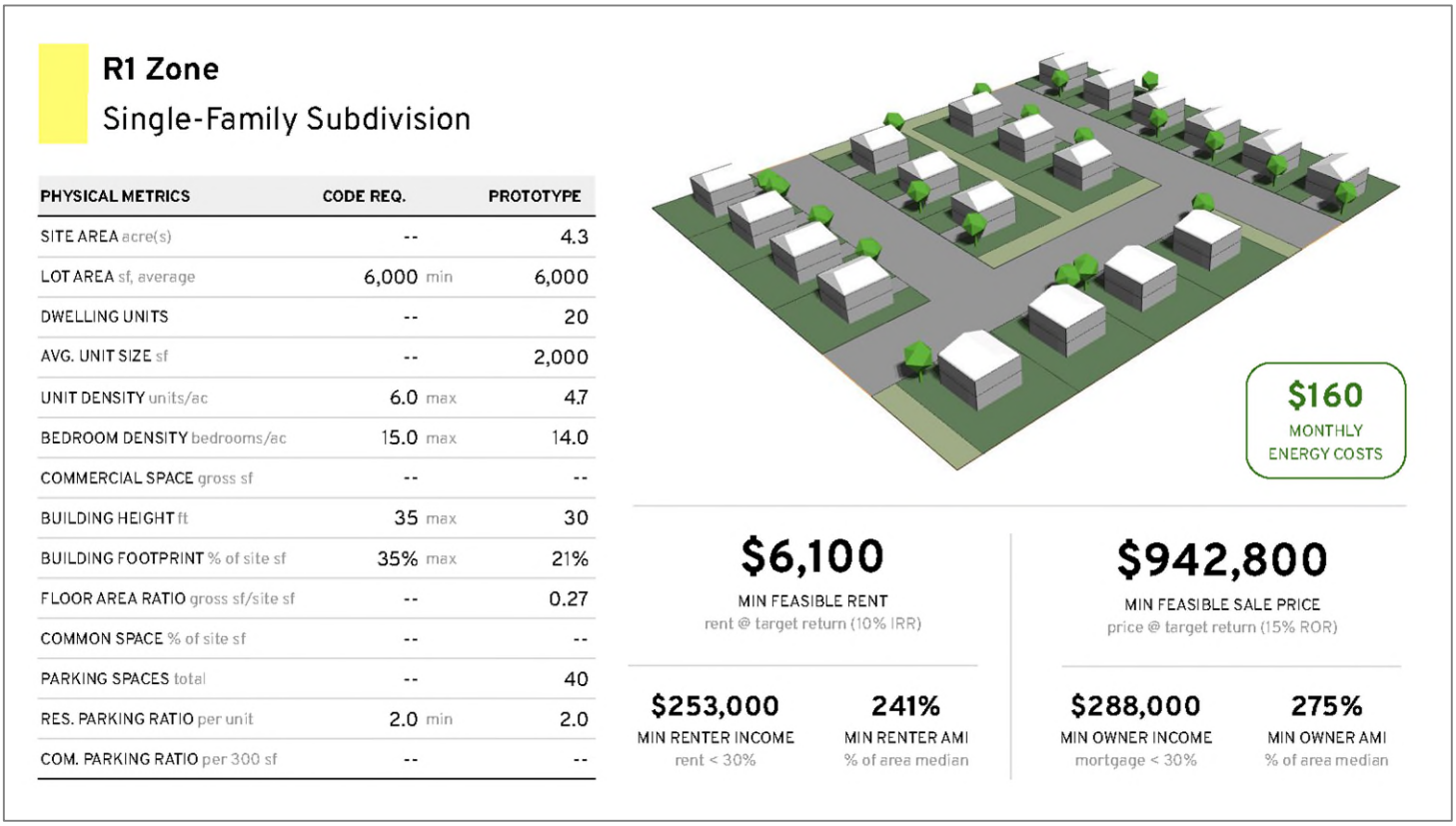
Further, the use regulations that apply to the zone will make it less likely that a developer would propose housing types with attached units. Attached units must either be designed as townhomes (single-family attached) or, in limited circumstances, may be permitted if the number of attached units is no greater than two. Given these restrictions, it will often be simpler and more profitable to construct detached units.

A triplex or quadplex can be compatible in form and character to single-family houses. These housing types have often been included as key elements of the "missing middle" between detached, single-family homes and mid-rise apartment buildings. The City's 10-Year Housing Plan identifies missing middle housing as a key opportunity to serve a wider range of housing needs. These forms of housing can add to housing supply and provide more lower cost housing options without compromising neighborhood character.

The Planned Residential Development (PRD) option can allow some flexibility on development standards which can reduce barriers to building single-family attached units and duplexes that are permitted in the zone. The PRD can be utilized for the development of new subdivisions to allow alternative lot area, lot width, lot depth, lot coverage requirements, and setbacks when additional design elements and common space areas are provided. The proposed design elements are elected by the property owner and are meant to represent the features of traditional neighborhood design.

However, the PRD does not allow developers to exceed the maximum density of the R1 zone of 5-6 units per acre. The prototype modeling found that it is possible to maximize density at 6 units per acre by continuing to build detached single-family homes and reducing the lot size to an average of 3,500 square feet. It was not necessary to include missing middle housing types or to reduce unit sizes in order to achieve the maximum density of the R1 zone. Therefore, we conclude that most developers will continue to build relatively large, single-family houses of about 2,000 square feet. By allowing projects to achieve the maximum density, the PRD will enable slightly lower cost of development compared to the base zone standards. However, it is unlikely to result in substantially more affordable homes.

Figure 1. R1 Zone Prototype Model



The R1N zone provides flexibility for alternative housing types, but the maximum density of the zone is unlikely to support infill of smaller, lower cost units.

The code articulates the purpose of the R1N zone as:

> *R1N. The Single-Family Residential Neighborhood (R1N) zone applies to those neighborhoods that are located between the City's Historic Downtown District and outlying areas of more recent suburban development. The R1N zone, therefore, helps to maintain and enhance the historic character, scale, and architectural integrity of the downtown and surrounding area.*

Unlike the R1 zone, the R1N allows for duplexes by right and permits a density level of 14 units per acre, higher than the 5-6 units per acre allowed in the R1 zone. The prototype model created for this zone assumed a duplex on a typical sized existing lot in the zone (9,100 square feet). The assumed unit sizes remained relatively large at 1,650 square feet, as there is no clear incentive to build smaller units because no more than two units per lot are permitted. The minimum feasible sale price of each of these units is about $825,000, while the minimum rent is $6,100. A household would need to earn at least 241% of AMI to afford to purchase one of these units, and at least 212% of AMI to afford to rent.

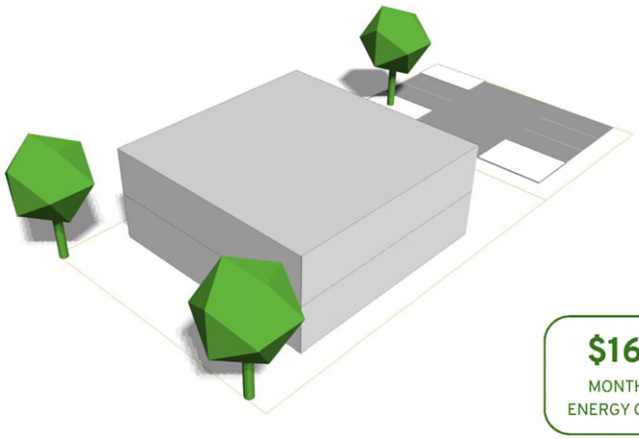
While the allowance for duplex at a slightly higher density than the R1 zone enables a minor reduction in feasible pricing, the financial returns of this project at market prices was relatively low. The economics of infill development are challenging due to the high cost of acquiring a site. To enable more housing supply and deeper affordability for infill projects, the R1N zone should allow more units per lot at a higher density level.

Figure 2. R1N Zone Prototype Model

R1N Zone

Infill Site Duplex

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	--
LOT AREA sf, average	6,000 min	9,100
DWELLING UNITS	--	2
AVG. UNIT SIZE sf	--	1,650
UNIT DENSITY units/ac	14.0 max	9.6
BEDROOM DENSITY bedrooms/ac	--	28.7
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	35 max	30
BUILDING FOOTPRINT % of site sf	35% max	23%
FLOOR AREA RATIO gross sf/site sf	--	0.59
COMMON SPACE % of site sf	--	--
PARKING SPACES total	--	4
RES. PARKING RATIO per unit	2.0 min	2.0
COM. PARKING RATIO per 300 sf	--	--



$168
MONTHLY ENERGY COSTS

$5,360
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$826,500
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

$217,000
MIN RENTER INCOME
rent < 30%

206%
MIN RENTER AMI
% of area median

$255,000
MIN OWNER INCOME
mortgage < 30%

242%
MIN OWNER AMI
% of area median

Low density development patterns may constrain overall housing supply, leading to worsening affordability.

At a citywide and regional scale, the low-density development pattern supported by the R1 and R1N zones may be contributing to the City's housing availability crisis. As fewer new homes are constructed with each development than might otherwise be economically feasible, the market is constrained from responding to market demand with sufficient supply. Over time, this can foster the tight housing market that the City is experiencing today. If population growth and household formation continue to be robust, as projected by the Regional Plan and other City studies, the lack of new housing supply will drive up competition for available units, leading to greater rates of appreciation than might be possible with more supply available on the market.

The R1 and R1N zones may contribute to creating exclusive, higher-income neighborhoods, perpetuate social equity issues such as segregation, displacement, and gentrification.

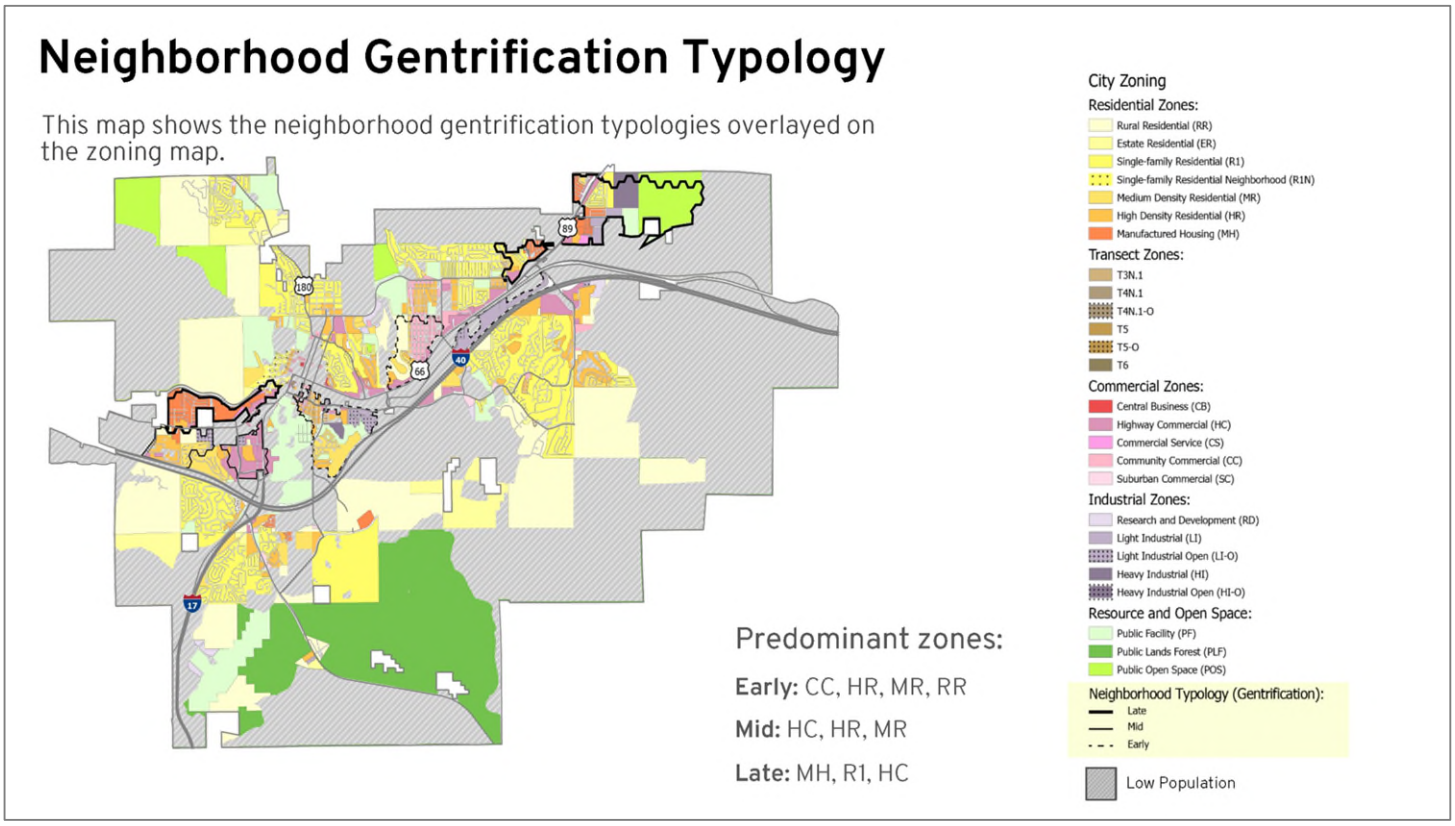
Given the economics of building housing at the density levels allowed by the R1 and R1N zones, it can be expected that most homes in R1 and R1N developments will only be affordable to upper middle- or upper-income earners. The lack of alternative housing types within these developments will contribute to creating neighborhoods that are socioeconomically homogenous. These neighborhoods will have higher rates of affluent households, well-educated households, and will have lower rates of communities of color. This pattern can lead to citywide patterns of residential segregation by income and race/ethnicity and inequitable access to amenities and services that are associated with residential development, including schools, parks, trails, and commercial areas.

Additionally, the R1 and R1N zones may contribute to creating the conditions for residential displacement and gentrification in neighborhoods with older housing stock and more households that are vulnerable to economic displacement. This dynamic occurs when housing supply in new developments is not sufficient to absorb the market demand. Middle- and upper-income households then seek housing options in other areas, driving up demand in existing, older neighborhoods.

There is evidence that displacement and gentrification is occurring in some neighborhoods in Flagstaff. The Displacement Vulnerability and Gentrification Risk Assessment (Appendix 4.2) evaluated demographic and housing market change to identify any neighborhoods in Flagstaff that may be experiencing higher rates of displacement or gentrification. These areas were classified as either in early, middle, or late stages of displacement gentrification. The areas were overlaid with the zoning map to identify which zones are predominant in areas experiencing these pressures, and which zones are predominant outside these areas (Figure 3).

The analysis finds that areas with higher density zoning are disproportionately represented in neighborhoods that are vulnerable to or experiencing gentrification. These areas are significantly more likely to be zoned High Density Residential (HR), Medium Density Residential (MR), Manufactured Housing (MH), or have commercial zoning that allows high density housing (HC and CC). The lack of housing supply and options in the R1 and R1N zones and other low-density zones outside of these areas is likely causing middle- and high-income households to seek housing options in neighborhoods with more permissive zoning, which drives up prices in these neighborhoods. Greater housing supply throughout the City, especially in new developments on the periphery, and more flexible (and equitable) zoning across existing neighborhoods, could alleviate the market pressures that are contributing to displacement and gentrification in existing neighborhoods.

Figure 3. Displacement Vulnerability Assessment and Zoning Map



4.1.5 Co-Benefits of Addressing the Barrier

Modifying the R1 and R1N zone standards to address the issues described above could advance both housing and climate outcomes. Table 3 summarizes the changes in development patterns that can occur through modifying the R1 and R1N zone and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 3. Co-Benefits Analysis, R1 and R1N Zone

New Development Pattern	Housing Outcomes	Climate Outcomes
More smaller units and attached units in new developments	• Diversity of Housing Types • Lower Cost Market Rate Housing	• Energy
Higher density in new developments and subdivisions	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Waste and Water • Electric Mobility

Increase in rate of infill and redevelopment in existing neighborhoods	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Waste and Water • Electric Mobility

4.1.6 Tensions with Other Policy Goals

Modifying the R1 and R1N zone standards as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Community Character and Design.** New developments that include a wider variety of housing types and higher density levels can have a different character and form than the surrounding neighborhood. However, this wider variety of housing types is consistent with Flagstaff's early, historic development pattern – seen in the higher density and more varied housing types in Townsite, Southside, and downtown.

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to serve new development, but there are challenges to designing and financing these systems as discussed in Section 6 of this report. There are also infrastructure efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

- **Historic Preservation.** The R1N zone is mapped to neighborhoods that may be designated as historic districts and/or include overlay zones with specific historic preservation regulations. Allowing higher densities and a wider range of housing types could result in more infill, redevelopment, and renovation of historic properties in these zones. However, these areas also include special design and development standards which may discourage redevelopment, limiting the impacts of any changes to base zoning standards.

The scope of the impact on these policy goals, as well as regulatory tools and strategies to mitigate these issues, will be evaluated more closely in later phases of the Code Analysis Project.

4.2 Medium Density Residential (MR) Zone

4.2.1 Summary

The Medium Density Residential (MR) zone allows for a variety of housing types and higher density levels than the R1 zone. However, the maximum density of the zone remains too low to encourage development of smaller dwelling units, which limits the potential for the zone to contribute to the City's housing and climate goals.

4.2.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🔵	Community Resilience, Health and Safety
🟠	Diversity of Housing Types	🟠	Sustainable Transportation Networks and Neighborhoods
🔴	Lower Cost Market Rate Housing	🔵	Electric Mobility
🟠	Income-Restricted Affordable Housing	🔵	Energy
🟠	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🔴	Infill Development and Compact Land Use	🟠	Healthy Forests and Carbon Dioxide Removal
🟠	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.2.3 Code Section(s)

- Residential Zones - MR: 10-40.30.030.A.5
- Residential Zones - Allowed Uses Table: 10-40.30.030.B.
- Residential Zones - Building Form and Property Development Standards Table: 10.40.30.030.C.

4.2.4 Analysis of Issues and Impacts

The code defines the purpose of the MR zone as follows:

> *The Medium Density Residential (MR) zone applies to areas of the City appropriate for moderate density residential. This zone allows a variety of housing types, including affordable and planned residential development that allow for higher densities.*

The MR zone allows single-family housing, duplexes and multi-family housing. The zone requires a minimum density of 6 units per acre and a maximum density of 9 units per acre if the site is in the RPO and 14 units per acre if the site is not in the RPO. The minimum lot size of the zone is generally 6,000 square feet, but the minimum scales up depending on the number of units on the lot.

The MR zone allows for lower cost housing types, but the maximum density of the zone limits the efficiency of building these types and encourages larger, more expensive units.

Two prototype models were created for the MR zone to test the feasibility and efficiency of building the housing types permitted in the zone. The first model was a typical “walk up apartment” complex with 2-3 story buildings and surface parking (Figure 4). The average unit size was about 900 square feet. This is a common apartment or condominium prototype that is widely developed in suburban contexts. However, the maximum density of 14 units per acre resulted in a very inefficient site plan; approximately 70% of the site remained in open space and building footprints accounted for just 15% of the site area. The minimum feasible sale price for units in this development would be approximately $541,000 and minimum feasible rents would be approximately $3,500. These units would be affordable to a household earning about 141-160% of AMI in Flagstaff.

The second prototype model was a townhome-style building that could either be subdivided into fee-simple townhomes or designed as a single site with condominium units or rental units (Figure 5). These are side-by-side attached units in two-story buildings. Unlike the garden apartment model, the units are not stacked. The average unit size was about 1,650 square feet. The internal streets are designed to meet City standards. It is important to note barriers to townhouse development in other relevant titles including Title 13. See Section 6.2.2 in Section 6 of this report.

As a result of the larger unit sizes and the area dedicated to full public streets, it is a more efficient site plan (58% lot coverage) than the garden apartment model with relatively little underutilized site area. However, due to the larger unit sizes, the units in this model would be significantly less affordable. The minimum feasible sale price for units in this development would be $753,100 and minimum feasible rents would be approximately $4,900. These units would be affordable to a household earning about 193-220% of AMI in Flagstaff.

Figure 4. MR Zone Prototype Model, 3-Story Apartments

MR Zone
Walkup Apartments/Condos

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	4.3
LOT AREA sf, average	6,000 min	187,000
DWELLING UNITS	--	56
AVG. UNIT SIZE sf	--	895
UNIT DENSITY units/ac	14.0 max	13.0
BEDROOM DENSITY bedrooms/ac	35 max	17.2
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	35 max	35
BUILDING FOOTPRINT % of site sf	35% max	14%
FLOOR AREA RATIO gross sf/site sf	--	0.32
COMMON SPACE % of site sf	15%	68%
PARKING SPACES total	--	98
RES. PARKING RATIO per unit	1.75 min	1.75
COM. PARKING RATIO per 300 sf	--	--

$82
MONTHLY ENERGY COSTS

$3,500
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$541,000
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

$143,000
MIN RENTER INCOME
rent < 30%

136%
MIN RENTER AMI
% of area median

$166,300
MIN OWNER INCOME
mortgage < 30%

158%
MIN OWNER AMI
% of area median

Figure 5. MR Zone Prototype Model, Townhomes

MR Zone
Townhome-Style Condos

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	4.3
LOT AREA sf, average	6,000 min	187,000
DWELLING UNITS	--	60
AVG. UNIT SIZE sf	--	1,600
UNIT DENSITY units/ac	14.0 max	14.0
BEDROOM DENSITY bedrooms/ac	35 max	34.9
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	35 max	30
BUILDING FOOTPRINT % of site sf	35% max	58%
FLOOR AREA RATIO gross sf/site sf	--	0.60
COMMON SPACE % of site sf	15%	23%
PARKING SPACES total	--	120
RES. PARKING RATIO per unit	2.0 min	2.0
COM. PARKING RATIO per 300 sf	--	--

$140
MONTHLY ENERGY COSTS

$4,900
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$751,300
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

$198,000
MIN RENTER INCOME
rent < 30%

188%
MIN RENTER AMI
% of area median

$231,000
MIN OWNER INCOME
mortgage < 30%

220%
MIN OWNER AMI
% of area median

The townhome-style building type prototype is more likely to be pursued by most developers. At a given project size (number of units), it will usually be more profitable to build larger units, so long as market demand is strong for units at that price point. If a higher density level were allowed, it may entice developers to either reduce unit sizes or switch to a different building type (such as the walk-up apartments) in order to add more units. At the current density level, relatively larger, more expensive units of 1,500-2,500 square feet will often be the more attractive project. However, the review of project case studies and recent permit data did not demonstrate this outcome. Additional research is needed in future phases of this project to better understand the underlying barriers precluding this building type. See additional relevant discussion in the Additional Minor Barriers and Issues in Section 4.11 (Public Improvements 10-30.50) and Section 6.4.4 Alleys.

4.2.5 Co-Benefits of Addressing the Barrier

Increasing the maximum density in the MR zone could advance both housing and climate outcomes. Table 4 summarizes the changes in development patterns that can occur through modifying the MR zone and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 4. Co-Benefits Analysis, MR Zone

Development Pattern	Housing Outcomes	Climate Outcomes
More smaller units in new developments	• Diversity of Housing Types • Lower Cost Market Rate Housing	• Energy
Higher density in new developments and subdivisions	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Waste and Water • Electric Mobility
Increase in rate of infill and redevelopment in existing neighborhoods	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Waste and Water • Electric Mobility

4.2.6 Tensions with Other Policy Goals

Modifying the MR zone standards as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Community Character and Design.** New developments at higher density levels can have a different character and form than the surrounding neighborhood. However, this wider variety of housing types is consistent with Flagstaff's early, historic development pattern – seen in the higher density and more varied housing types in Townsite, Southside, and downtown.

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to serve new development, but there are challenges to designing and financing these systems as discussed in Section 6 of this report. There are also infrastructure efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.3 Housing and Mixed-Use Development in Commercial Zones

4.3.1 Summary

Residential and mixed-use development is allowed in the commercial zones. However, density is limited to 29 units per acre or less in these zones unless the project is granted a CUP, which is only an option if the property is within an activity center. This low maximum density is a critical barrier to lower cost market rate housing and encourages an inefficient use of land. A CUP is also required to construct a standalone residential use, but this may not be the most effective approach for balancing the desire for both residential and commercial uses in these zones.

4.3.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🟠	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🔴	Lower Cost Market Rate Housing	🔵	Electric Mobility
🔵	Income-Restricted Affordable Housing	🟠	Energy
🔵	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🟠	Infill Development and Compact Land Use	🔵	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.3.3 Code Sections

- Commercial Zones - 10-40.30.040
- Commercial Zones - Allowed Uses Table: 10-40.40.040.B.
- Commercial Zones- Building Form and Property Development Standards Table: 10.40.30.040.C.

4.3.4 Analysis of Issues and Impacts

The City has six commercial zone districts:

- Suburban Commercial (SC)
- Community Commercial (CC)
- Neighborhood Community Commercial (NCC)
- Highway Commercial (HC)
- Commercial Service (CS)
- Central Business (CB)

The commercial zones are intended to provide for a range of commercial uses, while more strictly controlling some higher impact commercial uses in some zones. They also provide for a range of development intensities. Four of the six zones allow a maximum building height of 60 feet, while the SC and NCC zones allow 35 and 45 feet, respectively. The zones use Floor-to-Area Ratio (FAR) to regulate intensity, with FARs ranging from 0.8 to 3.0, with no maximum FAR in the CB zone. Generally, the HC and CB zone allowed the greatest intensity while the SC, NCC and SC zone the lowest intensity.

All of the commercial zones allow for residential uses with some varying regulations. Any residential use that is part of a mixed-use development is permitted outright. Duplexes and multi-family dwellings that are not part of a mixed-use development (single-use residential) are allowed with a CUP in all zones except in CC where duplexes are permitted by right on lots less than 9,000 square feet. Single-family dwellings not part of a mixed-use development are allowed outright in the CC and NCC zones if they are on lots less than 9,000 square feet.

Maximum density in the commercial zones is generally equivalent to the HR zone: 29 units per acre, reduced to 22 units per acre if the site is in the RPO and outside of an activity center. The SC zone is an exception, with a lower density of 13 units per acre, which does not vary if the site is in the RPO. As discussed in detail in Section 4.5, this maximum may be exceeded with approval of a High Occupancy Housing CUP.

Housing developments in commercial zones have been critical to partially meeting the demand for higher-density, multi-family housing in the City in recent years. According to building permit data, approximately 28% of all multi-family dwellings or multi-family dwellings in mixed-use developments has occurred in the commercial zones over the last 10 years. Most of these units have been in large, 5-story, student-oriented housing developments, which stimulated the community dialogue that led to the High Occupancy Housing-specific plan.

Commercial zones are also anticipated to play a key role in meeting future housing needs. The LASS report found there are 441 acres of buildable land in commercial zones in the study area. While this represents a relatively small share of all buildable land, these sites are more likely to be ready for development in the short term than some residentially zoned land. Approximately 70% of the Opportunity Sites (36 of 51) identified in the study are in commercial zones, with a large share in the CB zones on the periphery of downtown Flagstaff.

The low maximum density in the commercial zones is a critical barrier to lower cost market rate housing and encourages an inefficient use of land.

Section 4.5 of this report explains in detail why the maximum density of 22-29 units per acre is a critical barrier to lower cost multi-family housing development in the commercial zones. In summary, given the economics of housing development in commercial zones, this regulation effectively requires most multi-family housing in commercial zones to be approved through a CUP and be subject to the HOH standards. The CUP process is a strong deterrent for most developers.

A likely outcome of the maximum density and CUP requirement is that some housing projects will be proposed at less than 22-29 units per acre. If the project is a standalone residential use, then it will generally require a CUP for approval. Faced with this option, many developers would opt to pursue the HOH CUP, which requires a similar process but also allows substantially higher density and reduced parking requirements for smaller units.

Therefore, the only option for a by-right housing development in the commercial zones is a mixed-use development at a density of less than 22-29 units per acre. This density level would typically take the form of a 2-3 story mixed-use building with ground floor commercial space and surface parking (Figure 6). It could also take the form of a horizontal mixed-use development, with commercial buildings lining the street and residential behind. As will be discussed below, the commercial component of the project will likely have a net negative impact on the financial viability of the project. With only a small number of residential units to offset this impact, many of these projects will prove economically infeasible.

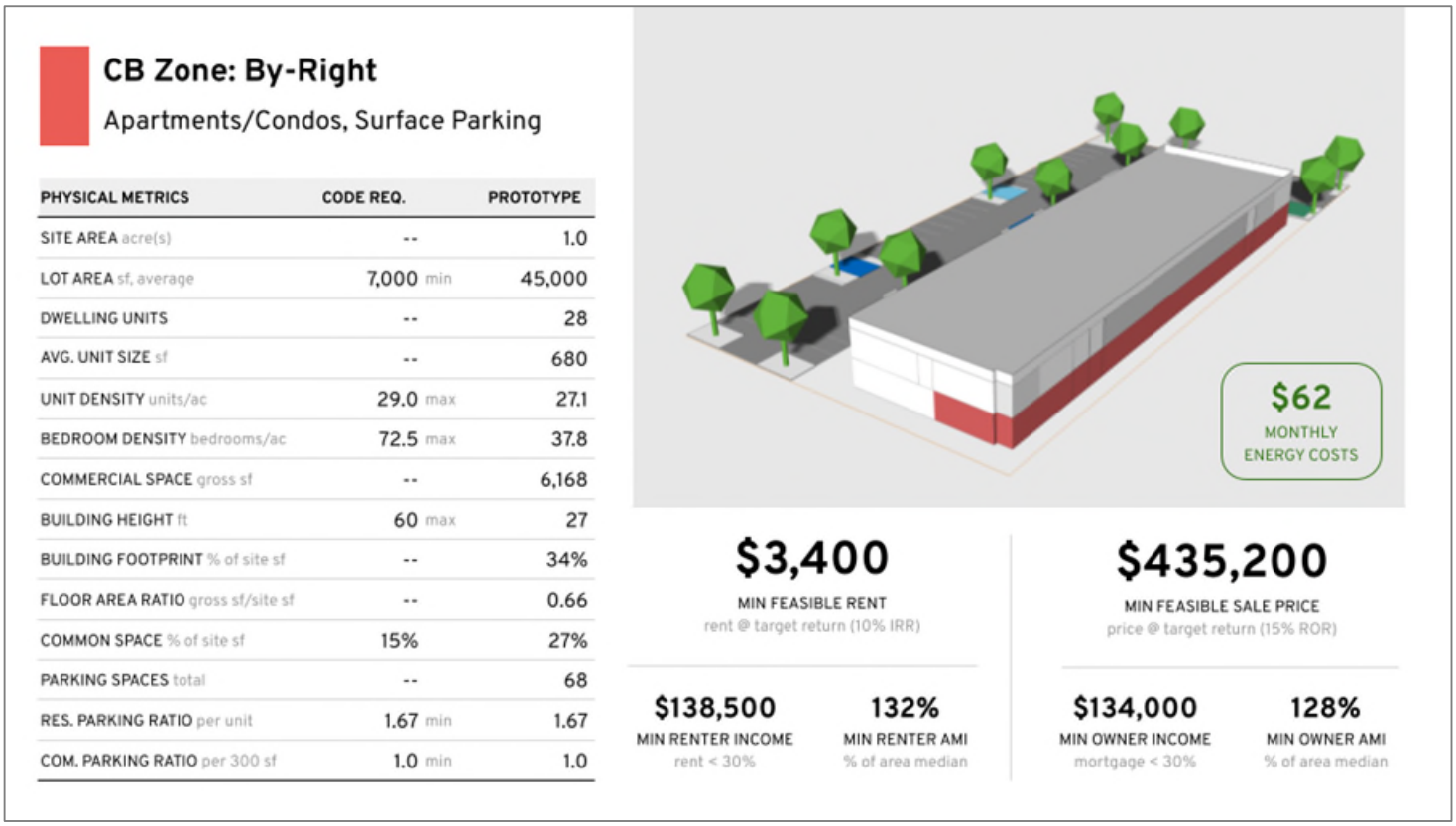
If we assume that some of these projects are viable, then it is not clear that they will contribute positively to meeting the City's housing and climate goals, for the following reasons:

- **Lower density encourages larger, more expensive units.** With density constrained at 22-29 units per acre, developers will be more likely to build larger units than if density was less constrained. While larger units are needed for some households, smaller units have strong climate and affordability benefits. Further, this density level is already allowed in the HR zone, so development at a similar density in the commercial zones would not contribute to providing for a wider range of housing needs in the City.

- **Uses land and infrastructure inefficiently and may lead to more development in sensitive natural landscapes and fire-prone areas.** The commercial zones are generally mapped to centrally located corridors and centers. If this land is not developed at high densities, more land will be needed in outlying residential zones to meet the demand for multi-family housing. This will entail higher infrastructure costs and greater potential to infringe on sensitive natural areas and areas with higher fire hazards. Growth in outlying residential zones also forces the need for vehicle ownership if public transit is not available.

- **This density level does not support transit ridership.** The commercial zones are mapped to many corridors that have existing transit service. Lower-density development in these areas will forgo opportunities to bring more households in close proximity to transit, supporting efficient transit operations and higher ridership. High density on these commercial corridors is particularly important because it offsets the lower density of surrounding residential areas.

Figure 6. CB Zone Prototype Model, By-Right Option



Requiring a CUP for a standalone residential development is not the most effective approach for balancing the desire for both residential and commercial uses.

As discussed above, the City currently requires a CUP approval for a standalone residential development in the commercial zones. As outlined in detail in Section 4.5 related to the HOH CUP requirement, this presents a significant process barrier to development, adds costs to the development process, and many developers will choose to design their project to avoid the requirement rather than request the CUP.

National economic trends are leading to a downturn in the demand for commercial space. The market for new office space has been severely impacted by work-from-home and remote work increases since the Covid-19 pandemic. Online retail and delivery services have weakened the demand for new retail space, which is often oversupplied in many markets. These market factors are limiting the viability of new commercial spaces, so many commercially zoned properties are more likely to be developed with standalone residential uses or mixed-use development than single-use commercial buildings. It is not within the scope of this study to evaluate the supply of commercial land in the City; however, so additional market analysis is necessary to conclude whether the City is oversupplied with commercial space or land.

In many locations, the commercial space is likely to have a net negative impact on the financial viability of the project. The rents for commercial spaces are generally lower relative to the cost of development than for residential units. Further, parking must be provided for the commercial

space, which can detract from the number of residential units that can fit on the site. For example, a mixed-use development on a 2-acre site would require 5,000 - 10,000 square feet of commercial space on the frontage, which would generate a need for an additional 17-33 parking spaces. If the developer is averse to pursuing a CUP for a standalone residential project, this may result in them simply not pursuing either project.

If developers do choose to include a commercial space in their project in order to avoid the CUP, that commercial space is less likely to be successful and may actually detract from the economic vibrancy of a commercial district. Commercial spaces that are placed in suboptimal locations or not designed to fit the market demand will be more likely to remain vacant for long periods of time. If this occurs, it brings into question whether a residential unit in place of that commercial space would actually contribute more positively to a commercial district.

There are other approaches to balancing the desire for commercial uses in commercial zones with the strong need and demand for housing. Alternative approaches could provide more certainty and predictability for the developer and the City while allowing high-density standalone residential projects in locations where commercial uses are less viable.

4.3.5 Co-Benefits of Addressing the Barrier

Modifying the commercials zones to lessen these barriers could advance both housing and climate outcomes. Table 5 summarizes the changes in development patterns that can occur through modifying the commercial zones and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 5. Co-Benefits Analysis, Commercial Zones

Development Pattern	Housing Outcomes	Climate Outcomes
More smaller units and in new multi-family and mixed-use developments	• Diversity of Housing Types • Lower Cost Market Rate Housing	• Energy
Higher density levels (over 29 units/acre) in new multi-family and mixed-use developments	• Abundant Housing Supply • Mixed Use Development and Neighborhoods • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Waste and Water • Electric Mobility
Increase in rate of infill and redevelopment in existing commercial areas	• Abundant Housing Supply • Mixed Use Development and Neighborhoods • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Waste and Water • Electric Mobility

4.3.6 Tensions with Other Policy Goals

Modifying the commercial zone standards as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Community Character and Design.** New developments at higher density levels can have a different character and form than the surrounding neighborhood. However, this wider variety of housing types is consistent with Flagstaff's early, historic development pattern – seen in the higher density and more varied housing types in Townsite, Southside, and downtown.

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to serve new development, but there are challenges to designing and financing these systems as discussed in Section 5 of this report. There are also infrastructure efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

- **Historic Preservation.** The commercial zones are mapped to neighborhoods that may be designated as historic districts and/or include overlay zones with specific historic preservation regulations. Allowing higher density could result in more infill, redevelopment, and renovation of historic properties in these zones.

- **Parking Management.** Changes to commercial zones may be paired with reduced parking requirements, which may be necessary to achieve higher density development in many cases. If so, then it is possible that there will be increased demand for on-street parking in some locations. This may present challenges associated with managing on-street parking and snow removal operations during winter months.

- **Availability of Land for Commercial Uses.** Encouraging more single-use residential developments in commercial zones could potentially detract from the availability of land for commercial uses or the accessibility of commercial uses for residents in nearby areas. It may be appropriate to consider strategies to mitigate this negative impact.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.4 Minimum Parking Requirements

4.4.1 Summary

Parking raises the cost of development and takes away land that could be used for additional residential units. Minimum parking requirements in Flagstaff vary by location, housing type, unit size/bedroom count, and whether the project is classified as High Occupancy Housing. The base minimum parking requirements are too high and are a barrier to some housing development depending on density level. As density allowances increase, parking may become more of a barrier to meeting density levels and achieving more affordable housing units The base parking requirement may be reduced in several ways if the project meets certain criteria. Despite these allowed reductions, the parking standards are a major barrier to more affordable medium density housing (14-29 units per acre) and a critical barrier to more affordable high-density housing (29 dwelling units per acre). Parking requirements for commercial space in a mixed-use development compound this challenge, as do additional guest parking spaces that are required for some uses. Lastly, high parking requirements for high density housing in transit-served areas directly conflicts with the City's climate and sustainability goals.

4.4.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🟠	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🔴	Lower Cost Market Rate Housing	🟠	Electric Mobility
🔵	Income-Restricted Affordable Housing	🔵	Energy
🟠	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🟠	Infill Development and Compact Land Use	🟠	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.4.3 Code Sections

- 10-50.80.030 General Parking Standards

- 10-50.80.040 Number of Motor Vehicle Parking Spaces Required

4.4.4 Analysis of Issues and Impacts

Minimum parking requirements can have a significant influence on the form, affordability, feasibility, and sustainability of development. The City's minimum parking requirements are detailed in Division 10-50.80: Parking Standards. The purpose of the parking standards is described as follows:

> *The purpose of this division is to regulate and ensure the provision of adequate parking and access for motor vehicles and bicycles. The division also provides options for the adjustment of parking requirements and to provide parking alternatives. These standards ensure that the parking needs of new land uses and development are met while being designed and located in a manner consistent with the desired character and development patterns of the community and as outlined in the General Plan.*

The statement alludes to the challenge of designing a parking code that ensures that developers limit negative externalities of providing too little on-site parking, while providing flexibility to adjust the requirements to better fit the use, location, and other factors unforeseen by the code.

The City has attempted to strike this balance by establishing a relatively complex structure and process for determining the amount of parking that will apply to any proposed development. For residential uses, base parking requirements vary by location (Transect vs. Non-Transect zones), housing type, unit size/bedroom count, and whether the project is classified as High Occupancy Housing. The base requirement may then be adjusted in several ways, such as if the project is near transit, includes affordable units, provides extra bike parking, or approved through a site-specific parking demand study (studies calling for more than a 15% reduction below the minimum parking requirements must be approved by City Council). Table 6 provides a summary of an analysis of minimum parking ratios that would be required for multi-family residential developments. The analysis focuses on multi-family and missing middle residential uses including duplexes because parking standards for single detached dwellings are not a significant barrier to development and have less influence on the form or affordability of housing in these developments. In order to account for variation in parking standards depending on the mix of unit sizes/bedroom counts within a development, three project types are presented with varying mixes of smaller and larger units.

Table 6 also summarizes the minimum parking ratio that could be approved if a project was granted the maximum reduction allowed by the code. Multiple options are available to a developer for reducing minimum parking requirements, but the code places a blanket "floor" on all reductions so that the cumulative amount of the reduction cannot be greater than 20% of the base requirement and the absolute parking ratio cannot be less than one space per unit (10-50.80.060).

Table 6. Minimum Parking Requirements for Multi-Family Developments and Duplexes

	Non-Transect Zones	Transect Zones (T3-T5)	HOH	HOH with Transit Pass	20% Affordable Project	100% Affordable Project
Base Minimum Ratio (Spaces Per Unit, Project Average)						
Smaller Unit Mix[1]	1.38	0.37 – 0.50	1.00	1.00	1.30	1.00
Balanced Unit Mix[2]	1.69	0.52 – 1.25	1.75	1.75	1.60	1.25
Larger Unit Mix[3]	2.25	0.92 – 2.25	2.50	2.50	2.15	1.75
Max Reduction[5]	20%	20%	20%	20%	20%	20%
Absolute Min. Ratio	1.0	0.0	1.0	0.65[4]	1.0	0.0
Effective Minimum Ratio with Max Reduction[6]						
Smaller Unit Mix[1]	1.10	0.29 – 0.40	1.00	0.80	1.04	0.80
Balanced Unit Mix[2]	1.35	0.41 – 1.00	1.40	1.40	1.28	1.00
Larger Unit Mix[3]	1.60	0.53 – 1.60	2.00	2.00	1.52	1.20

[1] Project includes 50% studio and 50% 1-bedroom units.
[2] Project includes an equal share of studio, 1-bedroom, 2-bedroom, and 3-bedroom units.
[3] Project includes 50% 2-bedroom and 50% 3-bedroom units.
[4] Minimum ratio per bedroom, not unit
[5] Parking reductions do not apply to duplexes.
[6] Max reduction accounts for all possible parking reductions including the transit parking adjustment

The extent to which these parking standards present barriers to meeting the City's housing goals depends, in part, on the density level of the project and the parking ratio (the climate impacts of parking ratios are addressed separately below).

Since parking in lower and medium density residential zones will most likely be provided in surface lots (or less frequently in wood framed garages or tuck under parking), the City's base minimum parking ratios have a minimal impact on development feasibility. However, at an average cost of $5,000 - $7,000, each parking space contributes to development costs and is reflected in the rent or sale price, therefore higher amounts of parking provided will increase housing costs. Further, the cost of off-street parking is often bundled with the rent or sale price, thereby increasing housing costs.

Parking requirements that exceed 2.0 spaces per unit could also place undue additional cost. This is especially true for middle housing types of development that are subject to additional guest parking space requirements on top of the base parking ratio. Guest parking requires an additional 0.25 spaces per unit for units that are 2 bedrooms or more. Existing parking reduction options could effectively lessen this barrier but may not be feasible for all projects.

Table 7 provides an evaluation of the impact of parking ratios on housing affordability and feasibility by zone district category. Parking ratios are rated on a scale of "Not a Barrier" to "Critical Barrier", using the definitions of these ratings provided at the beginning of Section 4 of this report. This evaluation is based on the prototype modeling conducted for this analysis,

developer feedback, local market conditions, and experience with similar standards in many other jurisdictions.

Table 7. Impact of Parking Ratios on Achieving Maximum Density

	Minimum Parking Ratio (Spaces Per Unit)			
Zoning Districts	**0.50 – 1.00**	**1.00 – 1.50**	**1.50 – 2.00**	**More than 2.00**
ER, RR, R1, MR, MH, SC, T1, T2 (less than 14 du/ac)	Not a Barrier[1]			Minor Barrier
HR, Commercial zones without HOH CUP, T3 (14-29 du/ac)	Not a Barrier[1]	Minor Barrier		Major Barrier
Commercial zones with HOH CUP, T4, T5 (more than 29 du/ac)	Minor Barrier	Major Barrier	Critical Barrier	

[1] Not a barrier to achieving maximum density allowed by zoning with a lower cost construction type; however, this ratio may still be a barrier to meeting climate goals that are related to lowering auto dependency and driving. This ratio may also become more of a barrier to achieving maximum density allowed if maximum density standards are increased.

The parking standards constrain flexibility and lessen development feasibility for projects in zones that allow 14-29 dwelling units per acre.

The parking ratios begin to present minor or major barriers to development feasibility and housing affordability for projects in the zones that allow up to 14-29 dwelling units per acre. This includes the High Density Residential (HR) zone, most commercial zones, and some building types allowed in the T3 Neighborhood transect zones. The prototype modeling for the HR zone showed that it is feasible to achieve a parking ratio of 1.69 at a density of 29 dwelling units per acre with 3-story walkup apartment buildings and surface parking. However, a large share of the site is consumed by surface parking, which may limit site design options. If the parking ratio exceeds 2.0 spaces per unit, it may become infeasible to meet minimum common space requirements without raising building heights to 4 stories. Common space refers to an amount of space in a development intended or reserved for the use and enjoyment of all owners and occupants, including but not limited to areas set aside for resource protection, passive and active recreation, gardens, and landscape areas. A 4-story building is substantially more expensive to construct due to increased building code requirements.

The parking ratio could likely be reduced to under 1.50 spaces per unit by applying for parking adjustments or reducing unit sizes in order to lessen this barrier, but this outcome may not be viable for all projects. The parking standards in the T3 Transect Zones are slightly lower than the Non-Transect Zones, so projects in the T3 zones in this density range are less likely to see parking as a major barrier.

The parking standards are a critical barrier to development feasibility and housing affordability at densities of over 29 dwelling units per acre.

In most commercial zones, multi-family residential projects may exceed 29 units per acre with a High Occupancy Housing Conditional Use Permit (HOH CUP). These projects are subject to the HOH parking standards. Building types and intensities allowed in the T4 and T5 Transect Zones would also allow projects over this density level. However, projects in the Transect Zones that exceed this density must also comply with the HOH requirements, so are subject to the HOH parking standards. Thus, although the Transect Zone parking standards are significantly lower and would only be a minor barrier to development at these higher densities, the standards are functionally irrelevant because most projects in the T4 or T5 zones would exceed density threshold of 29 units per acre for application of the HOH requirements.

The HOH parking standards are linked to bedroom count, not unit count like other standards in the code. The standards require 1 parking space per bedroom, with slightly lower ratios (0.70 to 0.90) for projects with a high number of bedrooms. For a typical multi-family project that includes a mix of unit sizes (the Balanced Unit Mix model in Table 6), this would equate to a parking ratio of 1.75 spaces per unit. This ratio could be lowered to 1.40 if the project participates in the Transit Pass Parking Reduction Pilot Program or by approval of a Parking Demand Study. The only other method of reducing the parking ratio would be to build smaller units (a higher share of studios and 1-bedroom units). However, this may not be a viable option for many projects.

If the parking reduction options prove infeasible, then these parking ratios will be a critical barrier to development of higher density housing for the following reasons:

- **Lower cost methods of providing parking are physically infeasible.** When required to provide 1.50 parking spaces per unit or greater and building at densities of 50 units per acre or higher, it is generally physically infeasible to accommodate those spaces in a surface parking lot. It is also usually not feasible to fit that amount of parking on the first level of a podium building (often called “tuck under” parking). A multi-level parking structure (above-grade or underground) is required to provide this parking, which is substantially more expensive than surface parking.

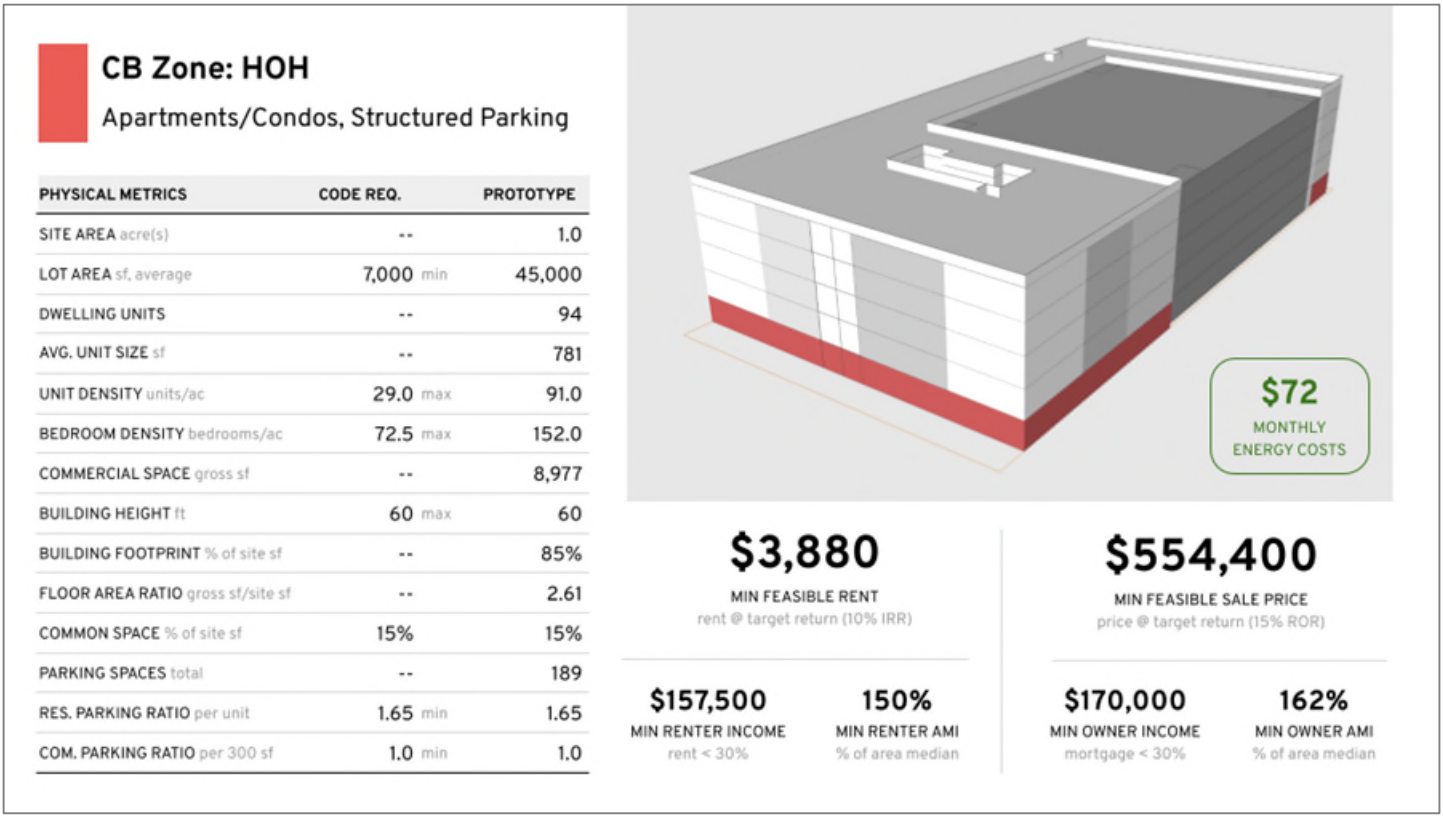
- **Multi-level parking structures are costly and inefficient on smaller sites.** While a surface parking space costs about $5,000-$7,000 per space to construct, a multi-level parking structure costs about $25,000-$35,000 per space. A reasonably efficient parking structure must be at least 120-130 feet in width and 150-160 feet in length. For reference, this is roughly the size of a quarter-block in downtown Flagstaff. On smaller sites (less than 1-2 acres), the parking structure will occupy more than half of the site, leaving little space to achieve the densities required for economic viability. All of the opportunity sites identified in the LASS report in the downtown Flagstaff area are under 2 acres in size. Further, smaller parking structures lack economies of scale of larger structures.

- **Maximum height and maximum building footprint standards compound the challenges of providing multi-level parking structures.** The City’s higher density commercial zones generally have a height limit of 45-60 feet. If a two-level parking structure (podium) is constructed with apartments above, this only leaves 1-3 stories available for housing, severely limiting densities required for economic viability.

Alternatively, the residential units could wrap around the outside of a 3-5 story parking garage, a prototype seen in many recent multi-family developments. However, this results in a very large building footprint. The prototype model for the CB zone, tested on a one-acre site, used this design and resulted in a building footprint of nearly 40,000 square feet, but the HOH standards establish a maximum building footprint of 22,000 square feet in the CB zone and in other commercial zones outside of the pedestrian shed of an Activity Center (Figure 7). The parking garage could be separated from the residential structure in order to comply with the maximum footprint standard, but this would complicate access to the residential units and result in a less attractive facade on the parking structure.

- **Underground parking structures are the most expensive to construct and are not always feasible in flood hazard areas.** The parking structure could be constructed below-grade in order to avoid the conflict with maximum height standards noted above. However, underground parking structures are very costly to construct, usually in the range of at least $35,000-$50,000 per space. Very high rents are needed to offset this cost. Further, underground parking may be legally or economically infeasible on sites in flood hazard areas, which impacts a significant share of commercially zoned properties in Flagstaff.

Figure 7. CB Zone Prototype Model, HOH Option



These challenges lead to one of the following three outcomes, all of which are not optimal for achieving the City's goals for housing supply and affordability:

- **The project is deemed economically infeasible and not constructed**. This represents an opportunity cost to the City of potential housing units that are foregone due to the parking requirements. Given the high supply of buildable land in commercial zones where this density level is permitted, this opportunity cost is likely substantial and contributes to the City's housing shortage.

- **The project is designed at a lower density which does not require a multi-level parking structure.** It is possible some projects will be viable at a lower density which does not require a multi-level parking structure. However, the units may need to be larger and targeted to higher income households in order to secure rents/prices that can offset the higher land costs per unit. Additionally, this outcome also represents an opportunity cost of potential housing units that are not constructed.

- **The project includes a multi-level parking structure, but higher development costs result in the units being affordable to fewer households.** If the site can accommodate a multi-level parking structure with a relatively high density, then the project may be constructed but would require higher rents/prices than would otherwise be required if fewer parking spaces were required.

Parking requirements for commercial space in a mixed-use development compound the challenge of meeting residential parking requirements.

The minimum parking ratios listed in Table 6 account only for the residential units on a site. As addressed in Section 4.3, a CUP is required to construct a standalone residential use in the commercial zones. This provides an incentive to construct mixed use development in the commercial zones in order to avoid the CUP. However, the commercial spaces included in a mixed-use development must also meet minimum parking requirements, which are set at 1 stall for every 300 gross square feet of commercial space. In addition, a higher number of Americans with Disabilities Act (ADA) accessible parking spaces are required for self-parking for employees and for all non-residential uses than is required by ADA regulations. As ADA spaces are larger in size and more challenging to accommodate for circulation and access, this current code requirement further complicates high-density mixed-use development.

The prototype models indicated that this parking requirement would raise the overall parking ratio (per dwelling unit) for a typical multi-family project from 1.50-1.75 spaces per unit to closer to 2.00 spaces per unit. This further compounds the challenges with providing this amount of parking when attempting to build at the higher densities that are necessary for market feasibility in the commercial zones.

High parking requirements for high density housing in transit-served areas is inconsistent with the City's climate and sustainability goals.

In addition to presenting barriers to housing supply and affordability goals, the parking requirements may detract from the City's ability to meet its climate and sustainability goals. Oversupplying parking can lead to the following issues:

- **Higher greenhouse gas (GHG) emissions and urban heat island impacts.** As the Building Code Diagnosis illustrates, concrete is one of the most carbon-intensive

building materials. If the parking requirements are resulting in higher volumes of concrete in parking structures than would otherwise be used, then they are directly contributing to higher GHG emissions. Building energy efficiency measures will have a minimal impact on net GHG emissions if there is a large amount of embodied carbon associated with a large concrete parking structure. In the case of surface parking, larger areas of asphalt parking lots can also contribute to urban heat island effects.

- **Discourages housing developers from responding to potential market demand for low-car lifestyles.** Some households or individuals would prefer to own no vehicles or just one vehicle for economic or environmental reasons. By requiring 1-2 parking spaces or more with each dwelling unit, the parking requirements result in the cost of parking a vehicle being bundled with the cost of housing. The requirements effectively prevent a developer from building a project where some or all of the units do not include access to an off-street parking space. If the requirements were lowered or eliminated, developers could respond to demand from this segment of the market by building units that do not include the cost of off-street parking bundled with the rent or sale price. De-coupling parking from rent can also create more affordable housing opportunities, where car-less or 'car-lite' residents can significantly reduce their monthly housing costs by not paying for parking they do not need.

- **May encourage higher vehicle ownership and driving.** In addition to preventing developers from serving households that are predisposed to not own a car or own fewer cars, recent research has found that the availability of off-street parking at residential buildings may actually cause higher vehicle ownership and driving among all households. There has been strong empirical evidence to support the theory that households that live in neighborhoods with good transit access, walkability, and bike infrastructure will use these modes of transportation more frequently and own fewer cars. However, research in recent years has isolated the impact of availability of off-street parking on transportation behavior, and found that abundant off-street parking may actually cause car ownership and use:

  > *Given that households who wish to own a car likely have numerous external parking options—to park on-street, park in a public garage, or rent a space in a nearby building—one might surmise that neighborhood-level rather than building-level parking supply would most affect transportation outcomes. However, we show that a building's parking ratio not only influences car ownership, vehicle travel, and transit use, but has a stronger effect than transit accessibility. Buildings with at least one parking space per unit (as required by zoning codes in most U.S. cities, and in San Francisco until circa 2010) have more than twice the car ownership rate of buildings that have no parking. If parking is provided on-site for free or at a reduced price (typically, $100 per month), then households appear to take advantage of this amenity. In contrast, households without access to on-site parking are more likely to forgo car ownership altogether[10].*

[10] Sources: Millard-Ball, A., West, J., Rezaei, N., & Desai, G. (2022). What do residential lotteries show us about transportation choices?. Urban Studies, 59(2), 434-452.

The benefits and impacts of reducing parking requirements are dependent on whether private developers continue to build similar levels of parking and whether actual demand for off-street parking aligns with the lowered supply. These outcomes may vary in different neighborhoods across Flagstaff that have varying levels of transit accessibility, walkability, and bike infrastructure.

4.4.5 Co-Benefits of Addressing the Barrier

Modifying parking requirements to lessen these barriers could advance both housing and climate outcomes. Table 8 summarizes the changes in development patterns that can occur through modifying parking requirements and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 8. Co-Benefits Analysis, Parking Requirements

New Development Pattern (resulting from reduced parking requirements)	**Housing Outcomes**	**Climate Outcomes**
More smaller units and in new multi-family and mixed-use developments	• Diversity of Housing Types • Lower Cost Market Rate Housing	• Energy
Higher density levels (over 29 units/acre) in new multi-family and mixed-use developments	• Abundant Housing Supply • Mixed Use Development and Neighborhoods • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Waste and Water • Electric Mobility
Increase in rate of infill and redevelopment	• Abundant Housing Supply • Mixed Use Development and Neighborhoods • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Waste and Water • Electric Mobility
Reduced use of concrete parking structures in new multi-family and mixed-use developments	• Lower Cost Market Rate Housing	• Energy

4.4.6 Tensions with Other Policy Goals

Modifying parking requirements as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to serve new development, but there are challenges to designing and financing these systems as discussed in Section 6 of this report. There are also infrastructure efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

- **Historic Preservation.** The zones where parking requirements are a barrier to development are mapped to neighborhoods that may be designated as historic districts and/or include overlay zones with specific historic preservation regulations. Enabling higher density by reducing parking requirements could result in more infill, redevelopment, and renovation of historic properties in these zones.

- **Parking Management.** Reduced off-street parking may result in increased demand for on-street parking in some locations. This may present challenges associated with managing on-street parking and snow removal operations during winter months.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.5 High Occupancy Housing Development Standards

4.5.1 Summary

The High Occupancy Housing (HOH) regulations that were adopted in 2021 are wide-ranging and have a significant impact on the review process and standards that apply to many higher-density housing projects. The low threshold for HOH requirements and a CUP in commercial zones (any project over 29 units per acre) is a critical barrier to meeting housing and climate goals due to the direct costs and opportunity costs associated with extended review timelines, uncertain conditions of approval, and risk of denial. The HOH standards also add unnecessary complexity to project design, raise equity and Fair Housing concerns, and dilute the effectiveness of the Affordable Housing and Sustainable Residential Building Incentives.

4.5.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🔵	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🔴	Lower Cost Market Rate Housing	🔵	Electric Mobility
🟠	Income-Restricted Affordable Housing	🟠	Energy
🔵	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🟠	Infill Development and Compact Land Use	🔵	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.5.3 Code Section(s)

- Definitions of HOHD types: 10-80.20.
- General requirements for all HOHD projects: 10-40.60.175
- Limitations on density and total number of bedrooms are provided in zone district regulations for both Non-Transect Zones (10-40.30) and Transect Zones (10-40.40)

4.5.4 Analysis of Issues and Impacts

The High Occupancy Housing (HOH) regulations in the Flagstaff zoning code were implemented as an outcome of the High Occupancy Housing Specific Plan ("HOH Specific Plan"), adopted in 2018. The HOH Specific Plan summarizes the purpose of the plan as follows:

> *The intent of the High Occupancy Housing (HOH) Specific Plan is to address how the City might promote viable options to increase density and provide more reasonably priced and diverse housing choices, while at the same time, continue to enhance the character and economic vitality of the City that is important to all. This issue of HOH arose from the community dialogue about new mid-rise buildings (4- to 6- stories) near existing and historic neighborhoods, and the impact of housing specifically catering to college students on the overall housing market.*

Few projects have been proposed which must comply with the HOH regulations, so there are few examples from which to draw conclusions about the effectiveness of the regulations in meeting the stated goals. As will be discussed below, it is possible that the HOH regulations have discouraged potential projects from being proposed due to the uncertainty of the review process, the complexity of the regulations, and the negative impact of the regulations on the economic feasibility of certain types of housing projects.

A project is classified as a High Occupancy Housing Development (HOHD) or Mixed-Use High Occupancy Housing Development (MUHOHD) if it meets certain thresholds for the density or number of units or bedrooms. These thresholds vary by housing type, zone district, and specific location within zone districts. In general, the underlying principle behind the thresholds is to apply HOH regulations to projects that are likely to have more significant impacts on the surrounding area due to the high population density that is proposed. These projects must apply for a Conditional Use Permit (CUP) and be approved by the Planning Commission, and are subject to special use standards (10-40.60.175).

Recognizing that dwelling unit density is an imperfect measure of population density or building occupancy, the thresholds use bedroom count, bathroom count, or bedroom density as supplementary measures. This is a reasonable approach for isolating projects with higher-than-typical residential occupancies. Our prototype modeling indicates that many projects with typical unit sizes and bedroom counts would not trigger the HOH thresholds based on bedroom count, bathroom count, or bedroom density. However, these thresholds may also be capturing projects that do not have residential occupancies or densities that necessarily require a special review process or criteria.

The low-density threshold for HOH requirements and a CUP in commercial zones is a critical barrier to lower cost market rate housing development in these zones.

The HOH regulations apply to any project in commercial zones that exceeds either 13 units per acre (in the Suburban Commercial (SC) zone) or 29 units per acre (in all other zones). These are low thresholds for requiring a CUP and applying special use regulations. Our prototype modeling indicates that a mixed-use project on a typical 1-2 acre site in a commercial zone would reach a density of 29 units per acre at just 2 stories in height with surface parking. The high cost of land in commercial zones requires higher densities for development to be

economically feasible. As a result, most housing projects in commercial zones would require a CUP and be subject to the HOH requirements.

On smaller sites, even relatively small multi-family housing projects would reach this density threshold. For example, a quadplex on a 5,000 square foot lot (35 units/acre) or a 12-unit condo building on a 10,000 square foot lot (50 units per acre), such as the project shown in Figure 8, would have triggered the HOH regulations if not built prior to their adoption.

Figure 8. Examples of Multi-Family Housing Over 29 Units Per Acre

A CUP is an appropriate tool for uses that have impacts that are difficult to anticipate or that may vary significantly depending on the specific location and context of the site. Any housing project that is over 29 units per acre in a commercial zone does not fit this definition. Most housing projects function in a similar manner and have predictable impacts that can be mitigated by applying clear and objective standards. Housing projects with very high occupancy and density levels (for example, apartment projects exceeding 100-150 units per acre on a large site) may have more significant impacts on surrounding properties than lower density multi-family housing, but the HOH regulations do not apply only to those projects.

A CUP is perceived as a higher risk by developers due to the uncertainty associated with the review process and longer approval timeline. There are three related, but separate issues caused by a CUP:

1. **Extended review timelines.** There are more steps involved in a CUP than the administrative Site Plan review process. A Concept Plan and Site Plan must be approved by staff prior to submission of the CUP application. A neighborhood meeting is required, then a project must be presented to the Planning Commission. The Planning Commission may request design changes or additional information to be prepared by the applicant, which can require additional meetings. This longer review timeline contributes directly to a developer's carrying costs, which are the costs of holding land or property (financing, insurance, taxes, etc.) while development plans are approved. Construction costs or financing costs (interest rates) may also increase during this review timeline.

2. **Uncertain conditions of approval**. The subjective approval criteria for a CUP adds uncertainty and risk by increasing the chances that significant changes to the site design or development program will be required in order to obtain approval. These changes do not always add significant cost to the development, but they often have an impact on the economic viability of the project. If the changes reduce the number of units or amount of floor area that can be built, they are more likely to impair feasibility and may even render the project not viable.

3. **Risk of denial.** Finally, there is always a chance that the project will be completely denied, which is a major financial risk for a developer. They will have already invested a significant sum in pre-development costs, including planning and design, to be able to submit their application for review.

As a result of these issues, some otherwise economically viable projects may not be pursued, and the City could forgo opportunities for new housing production. Further, projects that are pursued must absorb additional costs attributed to the discretionary review process. It is also reasonable to expect that the CUP requirement may encourage developers to maximize the number of units on each site in order to maximize returns and offset the increased risk associated with the CUP.

It is important to note that the original HOH Specific Plan recommended that a CUP be required for projects that reached a density over 50 dwelling units per acre, significantly higher than the thresholds of 29 units per acre in commercial zones that has been adopted in code.

The HOH rules dilute the effectiveness of the Affordable Housing and Sustainability Incentives

In addition to presenting barriers to any higher-density housing project in the commercial zones, the HOH standards likely reduce the effectiveness of the City's Affordable Housing Incentives and Residential Sustainable Building Incentives by offering an alternative pathway to receiving some of the benefits of the incentives in these zones.

If a developer desires to build a project that exceeds the maximum density of the commercial zones (13 or 29 units per acre), then they can pursue one of three options identified in Table 9. Assuming that the project is a private developer and is not proposing 100% affordable units, the HOH CUP is likely to be the most attractive option.

The density bonus provided by the Affordable Housing Incentives or Residential Sustainable Building Incentives is less attractive because there is no density cap for an HOH project. Maximum density is deferred to the discretion of the Planning Commission. If the Planning Commission does not limit density, the other regulations in commercial zones would allow densities of up to 90-100 units per acre. This is significantly higher than the density that the Affordable Housing Incentives or Residential Sustainable Building Incentives offer above the base density allowed in the underlying zone. A density of 90-100 units per acre is more consistent with 4-6 story, mixed-use residential developments that are permitted in these zones.

The parking reduction provided by the Affordable Housing Incentives is also less attractive as a result of the HOH standards. The HOH parking standards are generally 1 space per bedroom. If a project has a high share of studio or 1-bedroom units, then the parking required for an HOH project will be similar to or even less than parking required for a project that uses the Affordable Housing Incentives. Thus, the HOH provides a pathway for achieving a similar parking reduction as the Affordable Housing Incentives.

If a project is proposing some 2- or 3-bedroom units, then the HOH parking ratio is similar to the base parking requirement for multi-family dwellings. In this case, the parking ratio offered by the Affordable Housing Incentives may be lower, but not significantly lower (1.59 compared to 1.75). If the project is also within a quarter mile of a transit stop then a more significant reduction is available which could bring a typical project to a ratio of around 1.35 spaces per unit.

Lastly, even if the project chose to use the Affordable Housing Incentives, the project would still be subject to the HOH requirements and apply for a CUP if it exceeds the maximum density of the commercial zones. Projects with 100% affordable units are exempt from the HOH standards, but projects with a mix of market rate and affordable units continue to be subject to the HOH standards.

Table 9. Comparison of High Occupancy Housing, Affordable Housing Incentives, and Residential Sustainable Building Incentives in Commercial Zones[1]

Application Type	Maximum Density	Minimum Parking Required Per Unit[2]	Discretionary Review Required?
High Occupancy Housing CUP	None, only limited by other regulations. Effective achievable density up to 90-100 units per acre.	1.75, though may be lower for projects with predominantly studio/1-bedroom units.	Yes
Affordable Housing Incentives	5-45% above the base zone (31-42 units per acre)	1.60, may be reduced to 1.35 if within one-quarter mile of a transit stop	Yes, HOH CUP required, except for projects that are 100% affordable to households below 60% of AMI.
Residential Sustainable Building Incentives	25-50% above the base zone for market rate housing, and up to 50% above the base zone for housing that is also permanently affordable (36-43 units per acre). Code specifically exempts units allowed with density bonus from HOH requirements (10-30.70.030.B).	1.69, unless combined with affordable incentives	No, unless the project also includes a subdivision or if otherwise triggers a CUP, such as proposing a 100% residential project in a commercial zone.

[1] Assuming a multi-family residential project of 100 units in the CC, NCC, HC, CS, or CB zones.
[2] Average for a project with an equal mix of studio, 1 bedroom, 2 bedroom, and 3-bedroom units

In sum, if a developer desired to exceed the maximum density of the commercial zones, the Affordable Housing and Residential Sustainable Building Incentives would offer a similar or reduced level of benefit than pursuing an HOH CUP. While the CUP presents significant risks and uncertainty, the known costs of including affordable units or sustainability features could easily outweigh the risks associated with the CUP process, especially considering the ability to achieve higher densities through the HOH CUP than through the incentive programs.

Requirements specific to HOH projects may add unnecessary costs, complexity, and equity concerns.

Three of the use-specific standards that apply to all HOH projects (10-40.60.175) may also present unnecessary barriers to higher-density housing or present equity and Fair Housing issues:

- **Unit Conversion Plans.** One standard requires that an applicant demonstrate that the units in an HOH project could be converted to a more typical residential unit "with minimal structural or minimal plumbing modifications". Depending on how the City defines "minimal", this standard may be difficult to meet and require design choices that sacrifice cost or efficiency for convertibility. It is not clear the public benefit of this standard outweighs the impact on cost and flexibility for development.

- **Maximum Building Footprint:** The standards establish maximum building footprints that range from 5,000 to 22,000 square feet, depending on the location of the HOH. This is a reasonable approach to minimizing the scale and bulk of larger buildings. However, it limits the efficiency of some building types. Alternative approaches that achieve a similar purpose may better balance feasibility with reducing perceived scale.

- **Crime-Free Multi-Housing Program**: The HOH standards require that an HOH project enroll in the City of Flagstaff Police's Crime-Free Multi-Housing Program. Studies have evaluated these types of programs in recent years, and some research has found that these programs may be ineffective at reducing crime and may disproportionately impact protected classes, raising the prospect of violation of federal Fair Housing laws[11]. The City's 10-Year Housing Plan recommended studying if the City's existing program is causing similar disparate impacts. Evaluating the City's existing program is outside the scope of this project, but requiring enrollment in the program for all HOH projects may contribute to equity issues if these programs are found to cause disparate impacts. In contrast with the adopted code, HOH Specific Plan recommended not requiring enrollment in Crime-Free Multi-Housing Programs because they could "lead to limited housing choices for those who have been in domestic violence situations or have non-violent criminal convictions." (p. 18).

[11] Source: Urban Institute, Housing Matters Blog. *Legal Challenges to Crime-Free Housing Ordinances Bring Effectiveness into Question.*

4.5.5 Co-Benefits of Addressing the Barrier

Modifying the HOH regulations to lessen these barriers could advance both housing and climate outcomes. Table 10 summarizes the changes in development patterns that can occur through modifying the HOH regulations and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 10. Co-Benefits Analysis, HOH Standards

Development Pattern	Housing Outcomes	Climate Outcomes
More smaller units and in new multi-family and mixed-use developments	• Diversity of Housing Types • Lower Cost Market Rate Housing	• Energy
Higher density levels (over 29 units/acre) in new multi-family and mixed-use developments	• Abundant Housing Supply • Mixed Use Development and Neighborhoods • Infill Development and Compact Land Use	• Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Electric Mobility
Increase in rate of infill and redevelopment in existing commercial areas	• Abundant Housing Supply • Mixed Use Development and Neighborhoods • Infill Development and Compact Land Use	• Sustainable Transportation Networks and Neighborhoods • Healthy Forests and Carbon Dioxide Removal • Electric Mobility
More projects use Affordable Housing and Residential Sustainable Building Incentives because the HOH does not conflict with these programs	• Income-Restricted Affordable Housing	• Energy • Electric Mobility • Waste and Water • Healthy Forests and Carbon Dioxide Removal

4.5.6 Tensions with Other Policy Goals

Modifying the HOH regulations as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Community Character and Design.** New developments at higher density levels can have a different character and form than the surrounding neighborhood. Modifying some of the HOH regulations could result in more higher density developments. However, this wider variety of housing types is consistent with Flagstaff's early, historic development pattern – seen in the higher density and more varied housing types in Townsite, Southside, and downtown.

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to

serve new development, but there are challenges to designing and financing these systems as discussed in Section 6 of this report. There are also infrastructure efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

- **Historic Preservation.** The commercial zones re mapped to neighborhoods that may be designated as historic districts and/or include overlay zones with specific historic preservation regulations. Allowing higher density could result in more infill, redevelopment, and renovation of historic properties in these zones.

- **Parking Management.** Changes to commercial zones may be paired with reduced parking requirements and Transportation Demand Management (TDM) plans, which may be necessary to achieve higher density development in many cases. If so, then it is possible that there will be increased demand for on-street parking in some locations. This may present challenges associated with managing on-street parking and snow removal operations during winter months.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.6 Resource Protection Overlay Zone

4.6.1 Summary

The Resource Protection Overlay (RPO) seeks to preserve, manage, and mitigate defined natural resources (including floodplains, steep slopes, and forest). The RPO requires a large share of the resources on each site to be preserved, which constrains housing production and may have unintended consequences such as consuming more land and natural resources on a regional scale and placing more housing units at risk of wildfire hazards. The RPO also limits density more strictly than the base zone, but limiting density is not an effective tool for preserving resources.

4.6.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🟠	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🟠	Sustainable Transportation Networks and Neighborhoods
🔴	Lower Cost Market Rate Housing	🔵	Electric Mobility
🔵	Income-Restricted Affordable Housing	🟠	Energy
🔵	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🟠	Infill Development and Compact Land Use	🟠	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.6.3 Code Sections

- Section 10-30.20.040.B.1, Affordable Housing Incentives, Resource Protection Standards
- Section 10-50.90.030 Priority for Resource Protection
- Table 10-50.90.050.A: Slope Protection Thresholds

- Table 10-50.90.060.B.2.a. Forest Resource Protection Thresholds as a Percentage of Site Area
- Table 10-50.90.060.B.2.b.Forest Resource Protection Thresholds as a Percentage of Site Area
- Section 10-90.40.050, Resource Protection Overlay (RPO) Map

4.6.4 Analysis of Issues and Impacts

Natural resources, including open spaces, trails, recreation areas, mature trees and forests, watersheds and waterways, grasslands, wildlife corridors, and wildlife and plant habitats, are key defining features of the City of Flagstaff. These natural resources not only define the character of the City but also underpin Flagstaff's economy and community members' perception of quality of life. Careful management of these resources is also identified in City policies as critical to protect areas of development from natural hazards, such as flooding and wildfire. There is an expressed desire in the current adopted Regional Plan goals to balance conservation with development. The primary tool for addressing this outcome is the Resource Protection Overlay (RPO) and related standards.

The RPO maps out areas subject to the Overlay and provides standards that seek to preserve, manage, and mitigate defined natural resources (including floodplains, steep slopes, and forest). The intent of these standards is twofold; to maintain and protect natural resources while seeking development outcomes that are consistent with the character of natural surroundings.

The goals for RPO standards are outlined in the code as follows:

- Preserve significant natural resources characterized by unusual terrain, scenic vistas, unique geologic formations, and native vegetation;
- Preserve and enhance the natural environment, visual character, and aesthetic qualities of the City for its citizens' and visitors' enjoyment;
- Preserve and enhance the character and value of all properties;
- Preserve wildlife corridors and habitat;
- Prevent encroachment into floodplains
- Manage healthy and sustainable forests to reduce fire risk;
- Promote and improve the quality of the environment by enhancing air quality, reducing the amount and rate of stormwater runoff, improving stormwater runoff quality, and increasing the capacity for groundwater recharge; and
- Establish regulations for the preservation and protection of natural resources before, during, and after the construction and completion of a new development.

For a parcel located within the RPO, a resource survey must be conducted to identify natural resources and natural features on-site. There are three categories of natural resources that must be retained and protected; a minimum site area that must be set aside is defined for each of these three natural resources:

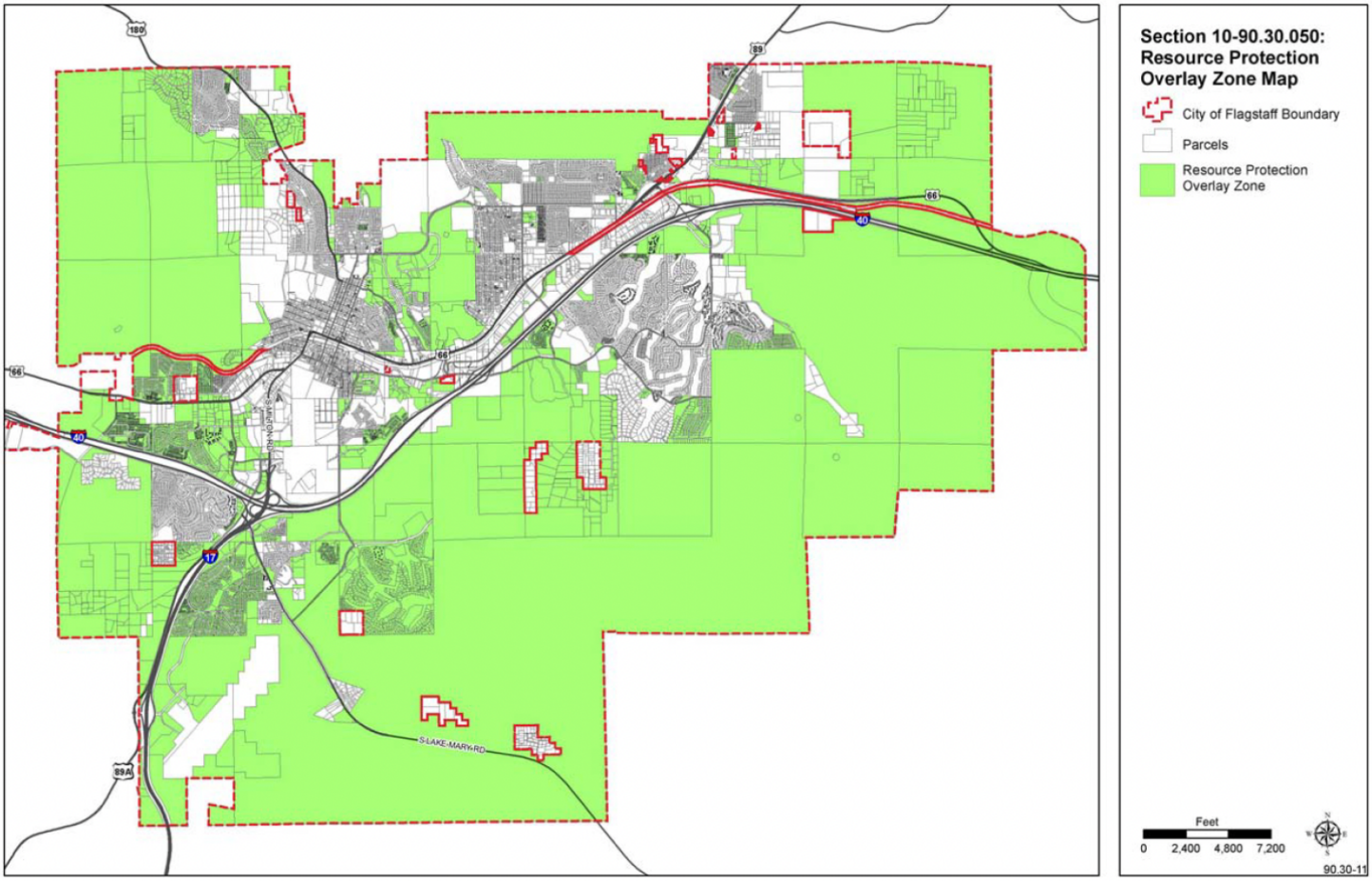
- **Floodplains:** Urban floodplains (with some limited exceptions) and rural floodplains are unsuitable for development and must be preserved.

- **Steep slopes:** Areas with slopes of 17% or greater must have a percentage of area protected corresponding to the degree of slope per Table 10-50.90.050.A. No development is allowed on slopes greater than 35%.
- **Forest:** Areas defined as priority forest resources must retain a minimum amount of forest area on site as percentage of total site area corresponding to specific land use zones per Table 10-50.90.060.B.2.a and Table 10-50.90.060.B.2.b. The amount of forest area is determined using a points-based system with points assigned based on tree size, with an emphasis on preservation of ponderosa pines. The emphasis is on preserving individual trees and not larger groupings of trees:
    - Forested areas connected to rural and urban floodplains;
    - Forested areas that connect to steep slopes;
    - Ponderosa pines with a diameter of greater than 18 inches;
    - Forested areas that connect to large, undeveloped, protected, or vegetated tracts of land within or adjacent to the site;
    - Native trees and native tree forests (other than ponderosa pines).

Above and beyond these three defined categories, the City can also take into account other on-site features, such as areas of geological interest and rock outcroppings. However, there is no mechanism in the code to regulate development around these features unless they are on a steep slope or they are needed for tree preservation.

As shown in Figure 9, the RPO is mapped broadly throughout the City. It primarily applies to properties that are not yet developed on the periphery of the community, but also applies to many areas directly adjacent to urbanized areas. The boundaries of the overlay zone follow property lines and not natural features. This is consistent with the approach to preserving resources, which requires developers to survey and inventory resources on a site-by-site basis, rather than applying resource area boundaries based on a citywide survey or planning study.

Figure 9. Resource Protection Overlay (RPO) Map



The RPO requires lower density than the base zone in addition to preservation of resource areas, but limiting density is not an effective tool for preserving resources

In addition to requiring a certain share of the natural resources areas on a site be preserved, the RPO establishes a lower maximum density standard than is allowed in areas outside the RPO. The density limit is about 65-85% of the maximum density of the base zone in most residential zones. Given that the RPO is mapped to a large share of the City's buildable land, this density restriction has a substantial, cumulative impact on housing capacity in the City.

The purpose of this additional density restriction is not explicitly stated in the code. It can be inferred that the intent is to mitigate the impact of development on natural resource areas. However, density is an imprecise measure of the impact of a development on natural resources. Density is simply a measure of the dwelling units per gross acre of land. A lower density development could have a similar or even greater impact on natural resources depending on the siting of the structures and improvements, the area of impervious surfaces, the size of the units and building footprints, grading and landscaping plans, and other factors. While the impact on natural resources may generally be greater for higher density developments, this is not guaranteed. If a general limitation on the intensity of development is necessary, there are better measures for impact on natural resources that do not directly limit housing production, such as impervious surface area.

The most effective method for ensuring that natural resources are protected is to require them to be inventoried and a certain share of the resources to be preserved. This is the primary method of the RPO. The resources that are currently protected in the code are trees and slopes. All other features are not protected by usable standards. If this method is not resulting in the preservation outcomes that the City intends, then it would be more effective to recalibrate the protection thresholds, rather than apply a blanket density limitation that is not guaranteed to result in preservation of additional resources.

The RPO requires a large share of the resources to be preserved on each site, which constrains housing production and may have unintended consequences at the citywide or regional scale.

The cumulative amount of site area that must be protected under the RPO standards is relatively high. A minimum of 60-100% of steeply sloped areas must be protected depending on the slope range. A minimum of 30-50% of forest resources must be protected. Forest resources are calculated using a point system; an overall minimum of 30% of gross site area is required to be preserved, regardless of point value. Depending on the share of the site that is in steep slopes, then it can be estimated that most sites in the RPO will be required to set aside a range of a minimum of 30-40% of the site for preservation.

This percentage must be considered alongside other site features that are required by City code which impact the amount of net developable area on the site and cannot overlap with resource areas. The most substantial of these areas are public streets and parking areas. Street design standards may require more area dedicated to right-of-way than is necessary for safe and efficient circulation. Minimum parking requirements may require more parking spaces than are necessary to meet demand. It is worth noting that open space requirements can be met within RPO portions of the site and therefore do not require an additional set-aside of undevelopable site area.

There are several standards in the RPO that contribute to the overall high level of site area that is required to be preserved that are impacting the City's ability to meet housing goals by reducing the amount of buildable land:

- **A minimum of 60-70% of areas with slopes between 17-25% are required to be preserved.** On some sites, a significant portion of the site will be in this slope category. The LASS report found that areas with 17-25% slope are common throughout Flagstaff, especially in areas south of Interstate 40 and around the JW Powell Corridor. These

moderately sloped areas are more costly to build on than relatively flat terrain, but not always cost-prohibitive. Allowing more development in these areas could have significant benefits for housing production while continuing to preserve more steeply sloped areas.

- **All residential non-transect zones require a minimum of 50% of forest resources to be protected, regardless of the maximum density of the zone.** The HR zone district, with a maximum density of 22 units per acre in the RPO, requires the same level of forest resource protection as the R1 zone, which allows a maximum density of 5 units per acre. It is significantly more challenging to preserve 50% of forest resources on a site when also attempting to build at densities allowed in the HR or MR zone.

- **Only a small portion of forest resources in steeply sloped areas can count toward forest resource protection requirements.** Where forest resources on a site overlap with steep slope resources, up to 25% of the forest resources in the steep slope area may be counted toward the required amount of forest resources for the entire site. This effectively penalizes sites with steep slopes in comparison to sites without steep slopes by not crediting the site for most of the forest resources that are preserved in sloped areas.

There are options to reduce the amount of forest resources required to be preserved or to mitigate for removals of resources that are in excess of the allowances in the code. However, these options are likely too limited to reduce the overall impact of the RPO standards or are offered only with discretionary review by the Planning Commission, which may be viewed as too uncertain to be approved and not pursued by many developers.

As a consequence of the large amount of site area that must be preserved under the standards, the RPO may be contributing to outcomes that are contrary to the purpose of the regulations:

- **Consuming more land and natural resources on a regional scale.** By requiring a lower density than the base zoning and making it difficult to achieve that density, the RPO may be contributing to greater overall consumption of land and natural resources. The demand and need for housing must be met at the regional scale; if each site includes fewer units due to the RPO, then it is likely that more sites are being developed to meet the given housing need. As a result, the net impact of the RPO could be to preserve more natural resources on each site that is developed, but preserve fewer natural resources in total as more land must be developed to meet housing demand.

- **Placing more housing units at risk of wildfire hazards.** The RPO regulations could be contributing to higher overall risk of wildfires impacting residential areas. By placing a high premium on preservation of existing trees, the standards may be encouraging more fire-prone trees to be placed on residential lots and near residential structures. On a site level, the standards could prevent this by more strongly encouraging trees to be preserved in stands/groves that are clustered further away from homes. On the regional level, if the RPO is leading to more land to be consumed at the periphery of the city as discussed above, then it is likely that it will result in more housing units being in close proximity to forests that are at risk of wildfire.

4.6.5 Co-Benefits of Addressing the Barrier

Modifying the RPO regulations to lessen these barriers could advance both housing and climate outcomes. Table 11 summarizes the changes in development patterns that can occur through modifying the RPO regulations and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 11. Co-Benefits Analysis, RPO Standards

Development Pattern	Housing Outcomes	Climate Outcomes
Higher density in new developments and subdivisions that are impacted by the RPO	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Waste and Water • Healthy Forests and Carbon Dioxide Removal • Energy • Electric Mobility

4.6.6 Tensions with Other Policy Goals

Modifying the RPO regulations as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Resource Protection.** Forests, steep hillsides, and floodplains provide a range of scenic and environmental benefits to the region, as described in the Regional Plan. These resources allow for healthy and functional natural systems and provide vital habitat and linkages for unique plants and animals. Their preservation is an important tool to reduce flooding, runoff, and erosion. Any modifications to RPO standards will need balance these benefits with the City's housing and climate goals.

- **Community Character and Design.** If the RPO standards allow higher density levels and reduce the amount of resource area that must be preserved, then new developments in the RPO may look different than current developments. Sloped areas may be more developed, and trees may be preserved in clusters/stands rather than being spread throughout the development.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.7 Affordable Housing Incentives

4.7.1 Summary

The Affordable Housing Incentives encourage the production of affordable units by providing increased densities and other incentives for developments that guarantee that a portion of the housing will be affordable. The number of incentives that can be granted to a project scales up depending on the depth of affordability, tenure of units, whether the units are preserved to be affordable permanently, and whether the projects also incorporate sustainability features. The financial benefit of using the incentives is unlikely to outweigh the costs of dedicating affordable units. This is due to decreased revenue from affordable units, a relatively low net gain of market rate units, and using the density bonus may require switching to higher-cost construction types. The incentives are less attractive than alternative pathways to achieving similar benefits that are offered by the code, including the Planned Residential Development option, Residential Sustainable Building Incentives, parking reductions, and HOH conditional use permit.

4.7.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
⚪	Abundant Housing Supply	🔵	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🔵	Sustainable Transportation Networks and Neighborhoods
⚪	Lower Cost Market Rate Housing	🔵	Electric Mobility
🔴	Income-Restricted Affordable Housing	🔵	Energy
⚪	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🔵	Infill Development and Compact Land Use	🔵	Healthy Forests and Carbon Dioxide Removal
🟠	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.7.3 Code Sections

Division 10-30.20: Affordable Housing Incentives

4.7.4 Analysis of Issues and Impacts

The purpose of the Affordable Housing Incentives, as articulated in Division 10-30.20, is as follows:

> *This division implements the City's Incentive Policy for Affordable Housing (IPAH), which is intended to foster the preservation and production of permanent affordable housing units. The division encourages the preservation and production of affordable units by providing increased residential densities and other developer incentives for developments that guarantee that at least a portion of the housing will be affordable.*

The incentives are voluntary. Developers of 100% affordable housing projects, usually non-profits but also for-profit firms, have used the incentives regularly. Private, for-profit developers that do not conventionally build affordable (income-restricted) units use the incentives less commonly. The incentives will only be used by these developers if the benefits (in terms of increased density or relief from other standards) outweigh the cost of dedicating some units to below-market-rate prices or rents.

The incentive structure is relatively complex. The number of incentives that can be granted to a project scales up depending on the depth of affordability, tenure of units, whether the units are preserved to be affordable permanently, and whether the projects also incorporate sustainability features. As such, there are four categories of projects:

- Category 1: Rental or ownership units affordable at 80% of AMI
- Category 2: Ownership units affordable at 100% of AMI
- Category 3: Rental or ownership units affordable at 120% AMI, plus the project includes sustainability features defined in Division 10-30.70.
- Category 4: Rental or ownership units affordable at 100% of AMI, but with no requirement for permanent affordability.

In general, Category 1 projects are eligible for a higher number of incentives while dedicating a lower share of units to be affordable than Category 2 or Category 3 projects. Category 4 projects are limited to one incentive, presumably because these projects only provide one-time affordability.

There are five types of incentives made available. Applicants may choose which combination of incentives to apply to their project. The incentives include:

- **Relief from Resource Protection Overlay Standards.** Two separate incentives are provided:
    - Allow forest resources areas that overlap with steep slope areas to count towards preservation requirements for forest resources (this incentive is also available to market rate developments in the RPO).
    - Reduce the forest resource requirement between 20-50% depending on affordability category and share of affordable units.
- **Density Bonus.** Allow 5-50% more units than allowed by base zone depending on affordability category and share of affordable units.

- **Parking Incentives.** Two separate incentives are provided:
    - A lower parking ratio is required for the affordable units on the site.
    - An additional reduction of required parking by up to 15% if the site is within a quarter-mile of a transit stop.
- **Adjustment of Property Development Standards:** Generally, the applicant is granted up to a 15% modification of any other development standard. A greater than 15% modification of some standards is allowed with City Council approval.
- **Landscaping Reduction:** Reduce minimum landscaping standards by 10%.

The Planned Residential Development option may negate the effectiveness of several of the incentives for subdivision projects.

The Planned Residential Development (PRD) process "provides a mechanism to allow alternative lot area, lot width, lot depth, lot coverage requirements, and setbacks" for subdivision projects (10-40.60.280.A). The development standards that may be adjusted through a PRD are the most common barriers to achieving the maximum density of the zone district. As such, for most subdivision projects, the Affordable Housing Incentives that grant a general reduction of development standards or reduction to landscaping standards are unlikely to be used because these incentives require dedication of affordable units. Dedicating affordable units is more costly than meeting the design requirements of the PRD process.

The RPO reduction incentives for affordable projects may also be valuable for PRD projects, however, as the PRD process does not allow for a reduction in the required forest preservation areas. Yet, the PRD may allow for a project to achieve the maximum density of the base zone district by using smaller lots and clustering away from resources. Therefore, the RPO reduction incentive for affordable units may be unnecessary for achieving maximum density in some circumstances. If a project needs to reduce the RPO preservation area and achieve densities higher than are allowed by the base zoning, then the Affordable Housing Incentives provide a marginal benefit above and beyond the PRD process.

There are alternative pathways to reducing parking requirements to a similar level offered by the incentives, but that are lower cost than providing affordable units.

There are two separate parking reductions allowed under the Affordable Housing Incentives. First, a lower ratio is applied to the affordable units in the development. Second, an additional 15% reduction is allowed if the project is located within a quarter-mile of transit.

For higher-density projects in the HR zone or commercial zones, the parking reduction incentive would be potentially attractive. The base parking standards are set at a ratio that may be higher than market demand, which both adds construction costs and requires more expensive methods of providing parking.

However, there are alternative pathways to reducing minimum parking requirements that may be more attractive for a private, for-profit developer who would otherwise not choose to provide

affordable units. The parking reduction under the Affordable Housing Incentives is limited for two reasons:

- **The lower parking ratio only applies to the affordable units, not the market rate units.** Assuming the project only provides the minimum number of units, then the lower ratio only applies to 10-20% of the units in the project. For example, for a project with a typical unit mix that provides 20% affordable units, the average parking ratio would only drop from 1.69 to 1.59 spaces per unit, a 6% reduction.

- **The additional reduction of 15% for projects close to transit is not significantly larger than the 10% parking reduction available for all projects that are close to transit.** Therefore, the net benefit of the parking reduction under the Affordable Housing Incentive is an additional 5% reduction. It is likely possible to achieve that additional 5% reduction through other means than the Affordable Housing Incentives, such as providing additional bike parking spaces.

The financial benefit of the density bonus is unlikely to outweigh the costs of dedicating affordable units.

The density bonus is likely the most valuable incentive for most projects. However, the financial benefit provided by the additional units is unlikely to outweigh the financial cost to the developer of providing the affordable units. As a result, using the incentive would have a net negative impact on the financial returns for the project and therefore it is unlikely it would be used except in certain circumstances.

The prototype models produced for this analysis indicate that projects that use the incentive would generally be less profitable than 100% market-rate projects that build fewer units. Table 12 compares the performance of a prototype built to the base density with two variations of prototypes using the Affordable Housing Incentives. The affordable projects resulted in a lower Internal Rate of Return (IRR) than the base density prototype. Additional tests were not conducted for other residential zones, but similar results are expected.

Table 12. Prototype Model Results, Base vs. Affordable Housing Incentives

Prototype	Site Area (acres)	Number of Units	Density (units per acre)	Building Height (stories)	Parking Ratio (spaces per unit)	IRR[3]
HR Zone - Base Density	4.3	120	28	3	1.69	4.5%
HR Zone - Category 1, 11% Affordable[1]	4.3	144	33	3	1.41	3.5%
HR Zone - Category 1, 20% Affordable[2]	4.3	180	41	4	1.42	3.4%
CC/HC Zone - Base Density	2.0	55	28	3	1.83	1.7%
CC/HC Zone - Category 1, 11% Affordable[1]	2.0	67	33	3	1.79	1.6%
CC/HC Zone - Category 1, 20% Affordable[2]	2.0	83	41	4	1.69	0.6%

[1] Assumes 20% density bonus and parking reduction incentive.
[2] Assumes 45% density bonus and parking reduction incentive.
[3] Internal Rate of Return, typical target is 10-12%

There are several reasons why using the incentives has a net negative impact on financial returns in the prototype models:

- **The cost to construct the affordable units is not significantly lower than market rate units, but the revenue from the affordable units is substantially lower.** The difference in construction costs for a deed-restricted affordable unit and a market-rate unit is marginal. Some savings could be expected from smaller units and more basic finishes, but not enough to offset the lower revenue. Construction costs have risen faster than incomes in recent years, so the negative financial impact of providing affordable units may be increasing.

- **The net gain in market-rate units from the density bonus is lower than it appears because the bonus density is inclusive of affordable units.** In accordance with the rules for calculating the density bonus (10-30.20.050), the number of bonus units is inclusive of the required affordable units. For example, a site with a base density that allows 100 units and that is eligible for a 20% density bonus would be permitted a total of 120 units. However, 10 of those units (10% of original base) must be affordable. Therefore, the project gains a net of only 10 market rate units (20 bonus units - 10 affordable units). Across all the categories of affordability, the density bonuses range from 5% to 50%, yet the net gain in market rate units is actually -5% to 30%.

- **Taking advantage of the density bonus may require switching to higher-cost construction types.** For projects in the HR and commercial zones, which allow a base maximum density of 29 units per acre, adding the units enabled by the density bonus may require using more costly construction methods. For example, the prototype that used the 45% density bonus (20% affordable units), required increasing from a 3-story to 4-story building in order to make space for additional surface parking for the bonus units.

Building code requires elevators in 4-story buildings and may require higher fire resistance ratings. In some cases, achieving the density bonus may also require more costly parking solutions, such as a building with a concrete podium that allows tuck-under parking or a structured parking garage. However, both of these cost elevations could be potentially avoided if the code required fewer parking spaces, or the incentives granted a larger reduction in parking requirements.

- **The density bonus and other incentives do not sufficiently account for differences in tenure type.** There are important differences in the market feasibility of providing affordable rental vs. ownership housing. However, the number of incentives and the percentage of units that must be affordable across these types does not vary significantly. For example, a more substantial incentive for ownership housing, which is generally more difficult to develop at affordable levels, may be more effective.

In sum, in order for the density bonus to have a net positive impact on the financial performance of a project, the total amount of the density bonus must be greater, and it must be paired with reductions in parking requirements to enable higher density while maintaining similar construction costs as the base density.

The Residential Sustainable Building Incentives may provide a lower cost pathway to a 25% density bonus than some of the Category 1 and Category 2 Affordable Housing Incentives.

The Residential Sustainable Building Incentives provide a 25% density bonus for providing sustainability features in a proposed development. A developer would need to provide approximately 10-14% affordable units to achieve an equivalent density bonus. If a developer sought the lowest cost pathway to achieving this level of a density bonus, it is probable that the sustainability incentives would cost less to the project than providing the affordable units. Thus, the sustainability incentives may be detracting from the effectiveness of the affordable housing incentives.

The High Occupancy Housing Conditional Use Permit offers an alternative pathway to increased density in the commercial zones that may be more attractive than the density bonus.

As discussed in detail in Section 4.6, the allowance for higher density and potentially lower parking ratios in the commercial zones through the High Occupancy Housing Conditional Use Permit may be detracting from the effectiveness of the affordable housing incentives. In combination with the sustainability incentives and the rezoning process, which also offer alternative pathways to higher density, it is probable that the affordable housing incentives are the costliest pathway to higher densities in the code. This may help explain the limited use of the incentives by private developers.

4.7.5 Co-Benefits of Addressing the Barrier

Modifying the Affordable Housing Incentives could advance both housing and climate outcomes. Table 13 summarizes the changes in development patterns that can occur through modifying

the incentives and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 13. Co-Benefits Analysis, Affordable Housing Incentives

Development Pattern	Housing Outcomes	Climate Outcomes
Higher share of income-restricted affordable units in new developments	• Income-Restricted Affordable Housing • Equity and Fair Housing	• Sustainable Transportation Networks and Neighborhoods[12]
Higher density in new developments and subdivisions that use the incentives	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Waste and Water • Healthy Forests and Carbon Dioxide Removal • Electric Mobility

4.7.6 Tensions with Other Policy Goals

Modifying the Affordable Housing Incentives as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Abundant Housing Supply.** If the base standards of the code (allowed housing types, maximum density, etc.) are not modified, but a higher density bonus is provided for projects that use the incentives, then it could compromise the City's efforts to increase overall housing supply. There must be a balance between providing sufficient housing capacity for market-rate housing while retaining the relative value of the incentives.

- **Community Character and Design.** New developments at higher density levels can have a different character and form than the surrounding neighborhood. However, this wider variety of housing types is consistent with Flagstaff's early, historic development pattern – seen in the higher density and more varied housing types in Townsite, Southside, and downtown.

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to serve new development, but there are challenges to designing and financing these systems as discussed in Section 6 of this report. There are also infrastructure

[12] Lower income households are more likely to use transit than moderate- or higher-income households, so developments with a higher share of low-income households may generate greater transit ridership.

efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

- **Parking Management.** Changes to incentives may be paired with reduced parking requirements and Transportation Demand Management (TDM), which may be necessary to achieve higher density development in many cases. If so, then it is possible that there will be increased demand for on-street parking in some locations. This may present challenges associated with managing on-street parking and snow removal operations during winter months.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.8 Residential Sustainable Building Incentives

4.8.1 Summary

The Residential Sustainable Building Incentives are a rarely used tool in the City's toolbox to encourage developers to construct energy and resource-efficient residential buildings. Projects applying for the bonus must meet the requirements for inclusion of sustainability features in four categories. However, the 25% density bonus may not reach a "tipping point" where the financial benefits of using the incentive outweigh the cost of compliance. This is because the bonus density may be not achievable due to other standards in the code, using the density bonus may require switching to higher-cost construction types, and the HOH CUP offers an alternative pathway to increased density in the commercial zones that may be more attractive than the density bonus.

4.8.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🔵	Abundant Housing Supply	🟠	Community Resilience, Health and Safety
⚪	Diversity of Housing Types	🔵	Sustainable Transportation Networks and Neighborhoods
🔵	Lower Cost Market Rate Housing	🔴	Electric Mobility
⚪	Income-Restricted Affordable Housing	🔴	Energy
⚪	Mixed Use Development and Neighborhoods	🔴	Waste and Water
🔵	Infill Development and Compact Land Use	🔵	Healthy Forests and Carbon Dioxide Removal
⚪	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.8.3 Code Sections

- Title 4: Building Regulations (see 5.0: Building and Fire Code Analysis for more details)
- Density Bonus: 10-30.70.030
- Percentage of Affordable Housing Units and Corresponding Density Bonus: Table 10-30.20.050.A

- Minimum standards for Water Resource Protection, Transportation and Air Quality, Waste Reduction and Management, and Energy Efficiency: 10-30.70.040
- 10-40.30.070.A.1 Sustainability Features

4.8.4 Analysis of Issues and Impacts

The Residential Sustainable Building Incentives are a key tool in the city's toolbox to encourage developers to construct energy and resource-efficient residential buildings. Encouraging more sustainable buildings is critical to Flagstaff meeting its goal of a carbon-neutral future by 2030. Reducing building energy, including reducing the heating, cooling, and power loads, will reduce the community's greenhouse gas emissions.

Due to the limitations set by Arizona State Statute 11-819, Flagstaff is not able to require some desired sustainability features but must rather incentivize them. Code section 10-30.70 is structured to offer additional density for a project if minimum standards are met in each area including water resource protection; transportation and air quality; waste reduction and management; and energy efficiency. A range of options are provided within each of the four categories.

Density bonuses are structured differently for affordable projects and market-rate projects:

- **Affordable** projects are granted Category 3 density bonus in Table 10-30.20.050.A under the affordable housing incentives provisions. The density bonus percentage increases as the percentage of permanently affordable units increases. Category 3 density bonuses cannot be combined with density bonuses in other categories.

- **Market Rate** projects are granted a 25% increase above the maximum density permitted in the designated zone. Any additional units and bedrooms generated through application of the bonus will not be included in the calculations for determining if a development is considered high occupancy.

Projects applying for the bonus must meet the requirements for inclusion of sustainability features in four categories:

- **Water Resource Protection:** These requirements require developers to choose from addressing landscape planting that use less water, irrigating with reclaimed water, using rainwater capture, or installing greywater plumbing.

- **Transportation and Air Quality:** These requirements require developers to provide charging for electric vehicles or locate in close proximity to existing transit.

- **Waste Reduction and Management.** This section requires a materials management plan, or a construction and demolition waste management plan.

- **Energy Efficiency.** This section provides three options for a certifiable all-electric, zero-energy, or energy-efficient building.

The incentives may be offering benefits for sustainability features that could be required for all projects.

A key decision in designing an incentive program is distinguishing between features that should be required of all projects and those bonus features that must be incentivized in order for them to be included in a project. Anecdotally, staff shared the Water Resource Protection, Transportation and Air Quality, and Waste Reduction and Management requirements appear to be relatively low-cost and straightforward to comply with. It is possible that these features, or some components of them, could be converted from bonus features to baseline requirements in the code, but the implications on the cost of development should be studied further before making this decision. Further, the sustainability features that are required by the incentives may be very easy to accommodate for one housing type (such as multi-family apartments) but relatively difficult to achieve with a different housing type (such as a single-family subdivision). Requirements that scale or adjust for different housing types would ensure that the incentives are calibrated based on how costly or difficult those sustainability features are to provide for a certain housing/development type. Additionally, the incentives do not offer any benefit to projects that construct transit facilities (stops, pullouts, etc.). The transit incentive is designed to simply benefit projects that are in close proximity to transit.

Providing all-electric buildings may be the most challenging requirement for private developers, but it is becoming standard practice elsewhere and is essential to the City's carbon neutrality goals.

Section 10-30.70.040. Energy Efficiency is the highest priority category for the City to better meet its climate goals. Building energy use is one of the top sources of carbon emissions. It is critical for the City to encourage residential projects that are all-electric and do not install natural gas plumbing and are constructed to a net-zero energy or highly energy efficient rating. This issue is discussed in more detail in the Building and Fire Code section of this report (Section 5).

However, developers have expressed a perception that all-electric and energy-efficient buildings and homes may entail higher upfront costs, even if longer term there may be cost savings for the end user. The perception is that these buildings require a potentially higher upfront investment in energy-efficiency and electric heat pump systems, as compared to buildings with less efficient systems or materials and/or using natural gas. This perception exists despite research showing substantial cost savings from not installing natural gas infrastructure and the fact that all-electric and energy-efficient investments generate substantial utility cost-savings over time. The perception of higher upfront costs is translated into higher sales prices, reflecting the market realities needing to balance costs with profit; also, developers will not be the end beneficiaries of long-term energy and cost savings. On the other hand, water conservation may directly benefit the developer or property manager since those costs are typically included in rental rates.

These perceived market challenges may help explain the limited use of the incentives; only four projects have used the sustainability incentives. Smaller projects with a low base density may also be less likely to use the incentives because the density bonus associated with the incentives is smaller.

The density bonus may not be an effective incentive for many projects.

On the other side of the ledger, the benefit of meeting the sustainability requirements – a density bonus of 25% – may not provide sufficient benefit for many projects in order to offset the cost of compliance. There are four situations in which a density bonus may not result in a net positive impact on the financial performance of a project:

- **The base density is not achievable due to other standards.** In some cases, it is not feasible to achieve the base maximum (or minimum) density allowed by the code due to other regulations that constrain density. Key examples include the limitations of the Resource Protection Overlay zone, minimum street widths, and minimum parking requirements. The sustainability incentives do not provide relief from these standards. If the bonus density is infeasible to construct, then the incentive has no value.

- **Taking advantage of the density bonus may require switching to higher-cost construction types.** For projects in the HR and commercial zones, which allow a base maximum density of 29 units per acre, adding the units enabled by the density bonus may require using more costly construction methods. This issue is described in more detail related to the affordable housing incentives in Section 4.7.

- **The total amount of the bonus is not enough to reach a "tipping point" where the financial benefits outweigh the perceived cost of compliance.** In some cases, a density bonus of 25% may simply not provide enough additional units to offset the financial cost of providing the sustainability features. The cost of providing some of the sustainability features are variable; they scale directly by the size of the development. This is especially true of the all-electric and energy-efficiency requirements. There are limited economies of scale. Therefore, the amount of the density bonus may need to be higher in order for the marginal benefit of using the incentive to exceed the marginal cost.

- **The High Occupancy Housing Conditional Use Permit offers an alternative pathway to increased density in the commercial zones that may be more attractive than the density bonus.** As discussed in detail in Section 4.6, the allowance for higher density and potentially lower parking ratios in the commercial zones through the High Occupancy Housing Conditional Use Permit may be detracting from the effectiveness of the incentives for projects in these zones.

4.8.5 Co-Benefits of Addressing the Barrier

Modifying the Residential Sustainable Building Incentives could advance both housing and climate outcomes. Table 14 summarizes the changes in development patterns that can occur through modifying the incentives and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 14. Co-Benefits Analysis, Sustainable Building Incentives

Development Pattern	Housing Outcomes	Climate Outcomes
Higher share of new developments uses the incentives and include sustainability features that are required by them.	• Lower Cost Market Rate Housing[13]	• Community Resilience, Health and Safety • Electric Mobility • Energy • Waste and Water
Higher density in new developments and subdivisions that use the incentives	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Waste and Water • Healthy Forests and Carbon Dioxide Removal • Electric Mobility

4.8.6 Tensions with Other Policy Goals

Modifying the Sustainable Building Incentives as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Carbon Neutrality**: As described in Section 5 of this report, some standards that are offered as incentives may be appropriate to require of all development. The City will need to balance the tension between setting an appropriate "floor" of requirements for all development while creating an achievable and attractive incentive at a level above that floor.

- **Cost of Development**. Modifying the incentives to require a higher level of energy efficiency or other building design changes can increase the cost of development, which may make it more difficult to provide housing options affordable to lower and moderate income households. It is important to evaluate the costs of installing more energy-efficient and all-electric features compared to the savings from not installing natural gas to better understand how these features impact upfront costs. There are also federal, and potentially future state, incentives that could help offset the costs of energy efficient and all electrical development.

- **Community Character and Design.** New developments at higher density levels can have a different character and form than the surrounding neighborhood. However, this wider variety of housing types is consistent with Flagstaff's early, historic development pattern – seen in the higher density and more varied housing types in Townsite, Southside, and downtown.

[13] Buildings that use the incentives may have lower utility costs due to greater energy efficiency. Household costs may also be reduced if the incentives make it easier to own an electric car, which can have a significantly lower total cost of ownership than a gas-powered vehicle.

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to serve new development, but there are challenges to designing and financing these systems as discussed in Section 6 of this report. There are also infrastructure efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

- **Parking Management.** Changes to incentives may be paired with reduced parking requirements and Transportation Demand Management (TDM), which may be necessary to achieve higher density development in many cases. If so, then it is possible that there will be increased demand for on-street parking in some locations. This may present challenges associated with managing on-street parking and snow removal operations during winter months.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.9 Zoning Map Amendment Review Process

4.9.1 Summary

A property owner may apply to the City for a rezoning if they are seeking to develop a different land use or a different intensity than is allowed by the current zone district. There are different procedures for rezonings based on the size of the development and whether or not a corresponding amendment to the General Plan is required. Regardless of the scale of project, all zoning map amendments must be approved by City Council and are subject to discretionary approval criteria, which presents significant uncertainty and risk for projects, especially smaller projects.

4.9.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🔵	Community Resilience, Health and Safety
🟠	Diversity of Housing Types	🔵	Sustainable Transportation Networks and Neighborhoods
🔵	Lower Cost Market Rate Housing	🔵	Electric Mobility
⚪	Income-Restricted Affordable Housing	🔵	Energy
🔵	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🟠	Infill Development and Compact Land Use	🟠	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.9.3 Code Sections

- Division 10-20.50: Amendments to the Zoning Code Text and the Zoning Map
- Division 10-20.40.060: Development Agreements
- Section 11-20.20.020. Major Plan Amendments and New Elements

4.9.4 Analysis of Issues and Impacts

A property owner may apply to the City for a rezoning if they are seeking to develop a different land use or a different intensity than is allowed by the current applicable zone district. For example, if a landowner intends to develop a subdivision with a range of housing types at a density greater than 1 unit per acre but the land is currently zoned Rural Residential (RR), they would need to apply for a rezoning to a residential zone designation that permitted the types of residential uses and densities they were targeting. The developer would also need to determine whether to pursue a Direct-to-Ordinance rezoning if they have an approved Site Plan or a concept rezoning with a Site Plan still in development. While there are two different pathways to a rezone that a developer may choose to take, both share similar barriers.

There are different application procedures for rezonings based on the size of the development and whether or not a corresponding amendment to the General Plan (the Regional Plan) is required:

- **Small-scale zoning map amendment**: Development of smaller sites that do not require an infrastructure analysis, are consistent with the General Plan, and compatible with surrounding development must conduct a site analysis and concept zoning plan. This scale amendment may not be required to submit a concept zoning plan.
- **Medium-scale zoning map amendment**: Developments that require an infrastructure analysis and a minor amendment to the General Plan must submit a concept zoning plan and must enter into a development agreement, if needed, to define applicant and City obligations.
- **Large-scale zoning map amendment**: Residential developments over 100 units or commercial, industrial, and other uses above a minimum square footage that require a major amendment to the General Plan, such as changes that have an impact on large areas or require amending the goals and policies of the Plan (Section 11-10.20.020) must submit a concept zoning plan, conduct citizen outreach, and a development agreement is required.
- **Multi-phase scale zoning map amendments**: Very large projects with complex development issues, including subdivisions of land, multiple land use types, utility and infrastructure issues, and the design and layout of street networks.

All zoning map amendments must be approved by City Council and are subject to discretionary approval criteria, which presents significant uncertainty and risk for smaller projects.

Regardless of the scale of zoning map amendments, and whether or not the Direct to Ordinance rezoning option is utilized, similar procedural steps apply. First the Director reviews an application for a rezoning using a concept zoning plan submittal. Staff conducts a review of the application, and the Director provides a recommendation to the Planning Commission detailing findings based on state enabling legislation. A recommendation is made based on whether the proposal is consistent with the goals of the General Plan, and any applicable Specific Plans; is not detrimental to public interest, health, safety, convenience, or welfare; and is suitable in terms of design, location, shape, size, etc. While these findings are state mandated, they remain discretionary in nature. For example, findings may include whether the affected site if rezoned will not “endanger, jeopardize, or otherwise constitute a hazard to the property or improvements

in the vicinity." The Planning Commission then holds a public hearing to consider the requested rezone and makes a recommendation to City Council. City Council is the ultimate approval authority for all rezones, regardless of their scale.

At a public hearing, City Council may choose to impose conditions on the approval of a rezone, including that "compatibility with adjacent land uses has been assured," and that the rezone "protect[s] the character and scale of the neighborhood." These are highly discretionary approval criteria and give the Council wide latitude to request additional conditions of approval. Section 10-20.50.040.N.2 lists conditions including: limiting allowable uses that are permitted within the approved zone; limiting height, setbacks, FAR, or other development standards more restrictive than those of the applicable zone; and requiring property not located within the RPO to still comply with resource protection standards. These conditions remain attached to the land, and the City may encounter remnant rezonings if a project with an approved rezoning does not end up being developed. The approval conditions and/or concept or site plans remain required even though they may no longer be desirable for a future project. This future project would need to pursue another rezoning to change the prior rezoning.

This lack of certainty of approval for a rezoning adds significant risk and carrying cost to a development proposal. A developer cannot rely on the land use regulations being the minimum standards as Council may impose additional or more extensive standards. The specific impact of this uncertainty on the development process likely results in fewer rezoning requests and potentially a substantial opportunity cost in fewer housing units produced.

While many rezoning proposals could have significant impacts on surrounding properties and public infrastructure, and therefore are appropriate to be reviewed by City Council, some smaller- or medium-scale zoning map amendments are less consequential. These types of rezones currently face a high hurdle in terms of the level of review applied and could facilitate increased housing production to support the City's goals.

Requiring a Development Agreement for most zoning map amendments complicates the development process and limits flexibility.

While there are other entitlement procedures that may trigger a development agreement, the most common procedure that requires a development agreement as a condition of approval is a zoning map amendment. Development Agreements (DA) are legally binding contracts between the City and a property owner or developer. DAs outline the terms and conditions under which a proposed development project, in this case a project requesting a rezoning, will be approved. DAs are a tool that allow the City to exercise a greater degree of control over the development process while offering the applicant a level of predictability that if they meet the specified conditions, they will receive approval.

On one hand the DA is a useful and powerful tool both for managing a complex development and a vehicle for the City to secure community benefits and affordable unit commitments. On the other hand, requiring this agreement for every zoning map amendment may present barriers to housing production and influence the types of housing development that are proposed:

- **Complicates developers securing project partners in early phases.** Some developers will self-finance the design work and feasibility studies necessary to secure a zone change in order to secure additional partners and investors after the zone change

is approved. The certainty granted by the zone change will make the project more attractive to lenders and investors. This allows the developer to take the project through the higher risk, early phases of the project without additional partners and investors. However, because a DA is required with the zoning map amendment, the developer will more likely need to secure all development partners prior to rezoning to ensure the terms will be agreeable to all parties.

- **Limits flexibility to respond to unforeseen challenges.** Conditioning the approval of the zoning map amendment on approval of a DA requires the developer to make specific commitments to a certain development plan. For example, the DA may specify the mix of unit types in the development, the number of affordable units and the AMI levels the units are restricted to, and the specific sustainability features that will be included. Also, Water and Sewer Impact Analyses (WSIAs) and Transportation Impact Analyses (TIAs) are required very early in the entitlement process before the development program is fully defined. Extensive time and money are spent preparing analyses that may be premature and require potentially significant changes later. However, City Council must approve modifications to a DA. Therefore, any changes will be delayed by an additional Council hearing process and will raise the possibility that Council requests additional modifications. Some developers may elect to try to work around the challenges rather than modify the DA, which may lead to a worse outcome for both the City and the developer.

- **Counteracts the flexibility that is offered by some of the City's zoning and subdivision standards.** The DA will include specific terms and conditions that will commit a developer to meet certain requirements. Those terms can often represent just one pathway for complying with the City's zoning and subdivision code. However, many sections of the code are structured to provide multiple pathways to approval, adjustments, and exceptions. These provisions provide options to respond to challenge that are unforeseen early in the development process. By requiring a DA that supersedes these provisions, it nullifies the flexibility the provisions were intended to provide.

The lengthy process and higher risk present a barrier in terms of substantial opportunity cost in fewer housing units produced. Perhaps more importantly, it may also encourage developers to develop at the densities that are permitted under the current zoning, which will be more likely to result in low density and larger homes that are less affordable to most households.

Specific plans are not a viable alternative to a DA for most projects.

An applicant can adopt a Specific Plan as a master plan for development as an alternative to seeking a Development Agreement. This tool presents another pathway to achieving a re-zone, however there are some notable limitations. Arizona State Statutes allow for two types of specific plans. A Specific Plan adopted by ordinance allows an applicant to meet adopted standards other than the development standards in the base zoning district. State statute limits the types of modifications that can be made, e.g., which types of standards can be modified. Specific plans can also be adopted by resolution. This type of Specific Plan is more akin to city policy providing direction on how to implement the Regional Plan.

Elements of a specific plan are spelled out in Division 11-10.30. Both Specific Plans adopted by ordinance and by resolution must include details about phasing, infrastructure and utilities, environmental assessment, traffic analysis and streets plan, natural resource protection, and compliance with the Regional Plan vision. While these types of project details are similar to what is required via a DA and allow the City to plan for impacts of larger development, there are some key differences. While a DA represents a contractual obligation to meet specific terms and conditions, including to pay for key infrastructure upgrades related to a project, Specific Plans do not have this level of commitment. Furthermore, since state statute restricts the types of modifications that can be made, they only allow an applicant a limited amount of flexibility. Lastly, Specific Plans adopted by ordinance remain a part of the development code and can encumber a piece of property with outdated policy and/or reduce staff's ability to respond to Regional Plan goals.

4.9.5 Co-Benefits of Addressing the Barrier

Modifying the Zoning Map Amendment process could advance both housing and climate outcomes. Table 15 summarizes the changes in development patterns that can occur through modifying the incentives and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 15. Co-Benefits Analysis, Zoning Map Amendment Process

Development Pattern	Housing Outcomes	Climate Outcomes
Higher overall rate of housing production due to more efficient and predictable review process and more projects proposing zoning map amendments	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Waste and Water • Healthy Forests and Carbon Dioxide Removal
Higher densities proposed with each project due to greater certainty of approval	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Waste and Water • Healthy Forests and Carbon Dioxide Removal • Energy • Electric Mobility

4.9.6 Tensions with Other Policy Goals

Modifying the Zoning Map Amendment process as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Community Character and Design.** New developments at higher density levels can have a different character and form than the surrounding neighborhood. However, this

wider variety of housing types is consistent with Flagstaff's early, historic development pattern – seen in the higher density and more varied housing types in Townsite, Southside, and downtown.

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to serve new development, but there are challenges to designing and financing these systems as discussed in Section 6 of this report. There are also infrastructure efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

- **Public Involvement.** City Council review of Zoning Map Amendments provides an opportunity for public engagement and input on important policy goals.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.10 Subdivision Review Process

4.10.1 Summary

Development projects that involve larger parcels of land, multiple uses, and more complex planning issues such as roads, utilities, or natural resources typically require a subdivision application. Title 11 requires a three-phase review process for subdivisions: Conceptual Plat, Preliminary Plat, and Final Plat. The City's requirement for a Conceptual Plat approval prior to submission of a Preliminary Plat is a step in the process that may be unnecessary and adds complexity and cost to the development process. City Council is the approval body for all subdivision applications, regardless of the scale or phase of the application. City Council approval may add unnecessary cost and delay for Preliminary Plat approvals or for all approvals for smaller subdivisions and condominium plats.

4.10.2 Impact on Key Outcomes

The table below illustrates the degree to which the current code creates barriers to achieving Flagstaff's key housing and climate outcomes. See the *Analysis* section below for an explanation of why the current code presents a barrier to the housing or climate outcome.

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🔵	Community Resilience, Health and Safety
🟠	Diversity of Housing Types	🔵	Sustainable Transportation Networks and Neighborhoods
🔵	Lower Cost Market Rate Housing	🔵	Electric Mobility
⚪	Income-Restricted Affordable Housing	🔵	Energy
🔵	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🟠	Infill Development and Compact Land Use	🔵	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

4.10.3 Code Sections

- Chapter 11-20: Subdivision And Land Split Regulations
- Division 10-30.50: Public Improvements

4.10.4 Analysis of Issues and Impacts

Development projects that involve larger parcels of land, multiple uses, and more complex planning issues such as roads, utilities, or natural resources are typically require a subdivision application. Platting is an important step in the development process for subdivisions where a blueprint is laid out identifying how the larger project will be developed into smaller parcels that meet city requirements. This platting approval process is intended to make sure new development adequately plans for future needs, meets public service requirements, pays its share of service costs, and meets larger citywide planning goals (such as providing a range of housing types and protecting natural resources).

In Flagstaff any improved or unimproved piece of land that is proposed to be divided into four or more lots, tracts, or parcels; two or more lots if a new street is provided; is classified as a subdivision (11-20.30.E (1)). As such, these development projects must be approved the procedure outlined below. There is a multi-step review process defined in Title 11 of Flagstaff's code that lays out the sequence of submissions required to receive approval for a proposed subdivision (11.20.40). These steps include:

- **Pre-Application Conference**: Initial outline of the subdivision proposal with the Director and City Engineer that should include sketch plans, land use ideas, street and lot arrangements/sizes, and conceptual proposals for utilities, traffic impacts, street improvements, and grading and drainage. At this point the City will share relevant standards and advise if a development master plan is needed (11-10.80).

- **Conceptual Plat:** Before proceeding to the formal platting review, a conceptual plat review occurs. The intent of this review is to highlight any concerns or additional information requests the City has for the applicant. Submittal must include a slope analysis, preliminary Natural Resources Protection Plan, preservation of scenic locations and view corridors, land use map, proposed configuration of lots and number of proposed residential units, proposed access and circulation plans, tentative scope of traffic impacts, proposed open spaces and trails, and tentative proposals for providing solid waste, sewer waste, storm sewers, and all other utilities. The materials are reviewed at Inter Division Staff (IDS) sessions by staff. Several rounds of review may be conducted before a Conceptual Plat is approved by the Director and City Engineer. Once this approval is received an applicant can move into formal platting.

- **Preliminary Plat**: Materials submitted for preliminary plat are similar to those submitted for conceptual plat, although with a greater level of detail. For example, the gross and net densities and maximum construction envelopes (including setbacks and lot coverage) must be submitted rather than just the number of proposed units. A key difference in this round of review is the submittal of impact analyses for traffic, stormwater, and city utilities. The application must also include documentation of requirements for all other public utilities and dedications, such as for schools, Arizona Department of Transportation (ADOT), County agencies, etc. After Director approval, preliminary plats are reviewed by the Planning Commission and then by City Council.

- **Final Plat**: A final plat must address all utility agency comments, record land to be dedicated to the City (including easements, roadway and trails, drainage ways, etc.), all floodplains, and a development phasing map and schedule.

The requirement for a Conceptual Plat phase may add unnecessary cost and delay to the subdivision review process.

The City's requirement for a Conceptual Plat approval prior to submission of a Preliminary Plat is a step in the process that may be unnecessary and adds complexity and cost to the development process. Most cities require a two-stage process (preliminary and final plat). The purpose of the Conceptual Plat process is to identify and prevent issues that may arise in the Preliminary Plat. However, the Pre-Application Conference also serves that purpose, and it is common for issues to arise and be resolved through the Preliminary Plat process. While it is only one additional step in the process, Conceptual Plat could be causing significant delays in approval because each submittal must be routed through the City's Inter-Division Staff (IDS) meetings and multiple reviewers, which can add several weeks to the timeline.

City Council approval may add unnecessary cost and delay for Preliminary Plat approvals or for all approvals for smaller subdivisions and condominium plats.

City Council is the approval body for all Preliminary Plat and Final Plat applications. Requiring City Council review and approval for all stages of the subdivision process and for all sizes of subdivisions may be causing unnecessary cost and delay for the development process. As described previously, City Council approval extends the length of the review timeline, adds uncertainty to the conditions of approval, and increases the perceived risk of denial. These factors all add tangible costs to the development process, including the opportunity cost of projects not pursued due to the perceived complexity and uncertainty of the process.

There may be opportunity to delineate between subdivision applications that require City Council review and approval and those that could be approved administratively or by the Planning Commission. For example, these types of applications may include:

- **All Preliminary Plat applications**. Final Plat applications could continue to be reviewed by City Council.
- **Preliminary Plat applications for smaller projects**. Subdivisions that impact a smaller area of land or propose creating a smaller number of lots (such as less than 10 lots or less than 2-5 acres) could be reviewed administratively or by Planning Commission. Final Plat applications could continue to be reviewed by City Council.
- **Preliminary and Final Plat for Condominiums**. Condominium, cooperative, or community apartment or townhouse projects that contains four or more parcels are classified as subdivisions. These are typically higher density housing types with smaller footprints that meet climate and affordability goals. Unlike a subdivision of single-family houses, these projects also have to be approved through the Site Plan process, so requiring City Council approval further extends the review timeline.

4.10.5 Co-Benefits of Addressing the Barrier

Modifying the subdivision review process could advance both housing and climate outcomes. Table 16 summarizes the changes in development patterns that can occur through modifying the incentives and the specific co-benefits of housing and climate outcomes that are encouraged by the change.

Table 16. Co-Benefits Analysis, Subdivision Review Process

Development Pattern	Housing Outcomes	Climate Outcomes
Higher overall rate of housing production due to more efficient and predictable review process	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Waste and Water • Healthy Forests and Carbon Dioxide Removal
Higher densities proposed with each project due to greater certainty of approval	• Abundant Housing Supply • Infill Development and Compact Land Use	• Community Resilience, Health and Safety • Sustainable Transportation Networks and Neighborhoods • Waste and Water • Healthy Forests and Carbon Dioxide Removal • Energy • Electric Mobility

4.10.6 Tensions with Other Policy Goals

Modifying the Subdivision review process as described above could result in development patterns that are in tension with other policy goals identified in the Regional Plan and other comprehensive plans:

- **Community Character and Design.** New developments at higher density levels can have a different character and form than the surrounding neighborhood. However, this wider variety of housing types is consistent with Flagstaff's early, historic development pattern – seen in the higher density and more varied housing types in Townsite, Southside, and downtown.

- **Infrastructure Sufficiency.** Higher density development can require more significant investments or upgrades to infrastructure systems such as sewer, water, stormwater, and streets. Standards are in place to ensure that systems are upgraded as needed to serve new development, but there are challenges to designing and financing these systems as discussed in Section 6 of this report. There are also infrastructure efficiencies that can be realized by building more densely with reductions in the cost per resident. See Section 6.

- **Public Involvement.** City Council review of Subdivision provides an opportunity for public engagement and input on important policy goals.

The scope of the impact on these policy goals, as well as regulatory tools and strategies mitigate these issues, will be evaluated more closely in later phases of this project.

4.11 Additional Minor Barriers and Issues

There are additional regulations in Title 10 and Title 11 which are important to address but are not considered major or critical barriers to meeting the City's housing and climate goals. Table 17 provides a list of these issues and a brief description of how the regulations presents a minor barrier to housing and/or climate goals.

Table 17. Additional Minor Zoning and Subdivision Barriers and Issues

CODE SECTION	DESCRIPTION OF BARRIER/ISSUE
Maximum density and minimum lot size for infill development on small, existing lots (10-40.30.030)	Maximum density and minimum lot size standards are often not calibrated to provide feasible development opportunities on existing, small lots. In many zones, the minimum lot size of 6,000 square feet could prevent any form of housing development on many older lots that are undersized. In zones that allow for attached housing types like MR and HR, the maximum density standard will limit these lots to only 2-3 units, which is usually not enough units to create an economically viable project. This issue is exacerbated in the HR zone because the maximum density of the zone is lower on smaller lots. Footnote 5 in Table 10-40.30.030.C sets the required lot area per dwelling unit between 1,500 and 2,500 square feet, depending on the lot size. For example, a 10,000 square foot lot in the zone is limited to 4 units; however, if the maximum density of the zone (29 units per acre) were applied to this lot, then 7 units would be permitted. To address this issue, the code could provide exemptions or increased density allowances that apply to development on existing, small lots. The regulation could apply only to lots created prior to a certain date in order to prevent new subdivisions on larger lots from using the standards and continuing to apply similar density regulations as today to larger sites.
Transect Zones (10-40.40)	The Transect Zones provide an alternative set of regulations for development in the areas surrounding the historic core of Flagstaff. An applicant may choose to use the Transect Zones in lieu of the Non-Transect Zones. In general, the Transect Zone development standards are supportive of high-density residential uses and a wide variety of housing types. The low-density caps and high parking requirements that are significant barriers to high density housing development in the Non-Transect Zone districts generally do not apply to the Transect Zone districts. However, the HOH regulations supersede the density and parking regulations of the Transect Zones, so most of the benefit of these zones has been nullified by the enactment of the HOH. Regardless of the benefits of the increased density and lower parking ratios enabled by the Transect Zones, some other form and design regulations of the zones have been found to be unnecessary barriers to housing development. While the standards are relatively clear and objective, they are also relatively prescriptive and inflexible. Consider the following examples for projects in the T5 Main Street zone: • Buildings must be placed within 2 feet of the right-of-way (ROW) (10-40.40.090.D). • The maximum distance between the exterior sidewalk and the ground floor finish level is 6 inches (10-40.40.090.E).

CODE SECTION	DESCRIPTION OF BARRIER/ISSUE
	• Ground floor ceilings must be a minimum of 14 feet tall (10-40.40.090.E). • Ground floor spaces must have a minimum depth of 30 feet (10.40.40.090.E). These examples and other standards are designed to achieve a very specific building form that can be found on many older commercial buildings on historic main streets. They produce a high-quality pedestrian experience on a street with commercial storefronts. However, they present unnecessary barriers and complexities for projects with housing on the ground floor. Residential uses on the ground floor function differently and would benefit from different approaches to creating an interesting, pedestrian-friendly experience. There are alternative regulations that can achieve a similar intent but are more appropriate for residential uses. The Transect Zones should be evaluated as a whole for other instances of design standards that are unnecessary barriers to housing developments.
Manufactured Housing (MH) Zone (10-40.30.030)	The purpose of the MH zone is articulated as follows: *The Manufactured Housing (MH) zone is applied to areas of the City appropriate for orderly planned development of manufactured housing parks and subdivisions to accommodate manufactured houses as a primary use. This zone also accommodates conventionally framed or constructed single-family residences and accessory uses that are related or incidental to the primary use and not detrimental to the residential environment.* The MH zone is the only zone that allows for manufactured homes and manufactured home parks. The zone provides opportunities for these needed, affordable housing types. Manufactured housing is a key strategy for making homes more affordable, with construction costs around 30% less than conventional stick-built single-family homes. Restrictive zoning that prohibits manufactured housing in most zones is a relic from when manufactured housing was lower quality than it is today. It may be appropriate to reconsider allowing manufactured homes or manufactured home parks in a wider set of zone districts. Additionally, the MH zone also permits single-family dwellings, and the maximum density of the zone (11 units per acre) is greater than that of the R1 zone. There are limitations to the use of manufactured homes and very few new manufactured home parks have been developed in recent decades. By allowing conventional single-family homes at a relatively high density, this runs the risk of land that is set aside in the MH zone being consumed by conventional single-family subdivisions.
Site Planning Design Standards (10-30.60) and Architectural Design Standards (10-50.20)	Some of the design standards in these two sections are relatively subjective and challenging to interpret both for applicants and staff. This may be contributing to a longer review process, greater uncertainty for developers, and more modifications of project designs, which can add costs. Further, some of these regulations appear to be redundant or addressing similar topics, which may contribute to confusion about which

CODE SECTION	DESCRIPTION OF BARRIER/ISSUE
	regulation is the applicable standard. There is currently no parallel track of clear and objective standards. Examples of these regulations include: • 10-30.60.030 – General Site Planning Standards • 10-30.60.050 – Compatibility • 10-30.60.060 – Building Placement • 10-50.20.030.B. – Building Massing and Scale Additionally, many of these standards are appropriate for larger multi-family or commercial developments but are ineffective or present unnecessary barriers and complexities when applied to smaller scale, missing middle housing types. A duplex, triplex, quadplex, or small row of townhomes do not have the same visual impact as a 5-story apartment building or large format retail center. Applying these designs standards to smaller scale housing projects creates unnecessary complexities.
Townsite Overlay Zone (10-40.50.030.A.5)	The Townsite Historic Design Review Overlay District Design Standards and Guidelines are similarly subjective as the general Site Planning and Architectural Design Standards (discussed above) and may present similar barriers to infill development in this neighborhood. It may be possible to replace some of these subjective guidelines with more objective standards and to lessen barriers to infill development, while continuing to advance the underlying goals of the Overlay Zone.
Landscaping Standards (10-50.60)	Residential developers raised concerns with some of the landscaping standards. In some cases, the standards may be requiring a higher volume of plantings (particularly trees) or consume more site area than is realistic or necessary, especially on smaller infill lots. The requirements may also be resulting in plantings that require higher water use than necessary and conflict with climate goals, despite allowances for xeriscape landscaping and standards that encourage use of non-potable water.
Mixed Use Standards (10-40.60.260)	The standards that apply to all mixed-use development may present unnecessary barriers to this highly desirable form of development. Some of the requirements are relatively prescriptive. While they may represent the ideal form of mixed-use development, other designs may achieve similar housing and climate goals. Examples include the minimum depth of commercial spaces and limitation on any residential units on the ground floor if facing a primary street. Other standards are subjective and may be redundant with regulations in other code sections. The prescriptive approach of these regulations may dissuade developers from building mixed use projects and opting to apply for a CUP to build a standalone residential project in the commercial zones.
Accessory Dwelling Unit Standards (10-40.60.030)	Accessory Dwelling Units (ADUs) are a proven strategy for increasing housing supply and providing a range of benefits, including multi-generational living, new housing options in existing neighborhoods, and smaller units. The allowances for ADUs are generally supportive of their development; however, several key regulations may present unnecessary barriers to homeowners investing in the construction of an ADU. A key barrier is the requirement for a parking space for the ADU, in addition to the parking spaces for the primary dwelling. Many existing homes were not designed to be able to accommodate another parking

CODE SECTION	DESCRIPTION OF BARRIER/ISSUE
	space and may not even meet current requirements for the primary dwelling. Some design standards may be subjective and unnecessarily restrictive, including Architectural Compatibility (10-40.60.030.C.4), Entrance (Architectural Compatibility (10-40.60.030.C.4), Number of Occupants (10-40.60.030.C.4) and Findings for Approval of ADUs (10-40.60.030.F).
Concept Plan Review (10-20.30.050) and Site Plan Review and Approval (10-20.40.140)	Any project requiring a Site Plan review, change in use that triggers an increase in parking, or proposed duplex, in addition to a handful of other conditions, is required to undergo Concept Plan review prior to a Site Plan review. The purpose of this process as stated in the code is: *"…to ensure that the applicant is aware of the procedures and substantive requirements of the City and to identify any potential problems or concerns prior to submitting for site plan review and approval."* Feedback from developers and review of example projects indicates that the Concept Plan process may be achieving this purpose, but it is doing so at a substantial cost to applicants in terms of time spent preparing submittals and extension of the overall review timeline. In most jurisdictions, this purpose is achieved by requiring applicants to prepare materials for a formal Pre-Application Conference. This conference is relatively in-depth and systematic in order to identify anticipated issues and to highlight regulations and code sections that the applicant may not be aware of. However, it does not require an extensive set of submittal documents, or a highly designed plan set, which is required for a Concept Plan.
Public Improvements (10-30.50)	This division of the code requires any project larger than a duplex (more than 2 units on one site) to provide full public improvements, including streets, curb, gutter, sidewalk. On infill lots, this requirement can present a significant barrier to missing middle housing types such as a triplex, quadplex, or small row of townhomes. Upgrading an existing street frontage to meet current standards is a significant cost. In many existing neighborhoods where these missing middle housing types would be permitted, streets are substandard (lacking full curb, gutter, and sidewalks). Additionally, building frontage improvements on a site-by-site basis as new development occurs can also create a patchwork of improvements in these neighborhoods, with sidewalks in short segments that do not provide continuous connectivity throughout the neighborhood.

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT– DEVELOPMENT CODE DIAGNOSIS

5

BUILDING & FIRE CODE ANALYSIS

GBD

5.0 BUILDING & FIRE CODE ANALYSIS

5.1 Purpose

The purpose of this section is to address Task 3.4 of the consultant scope of work and provide preliminary findings regarding the impacts of the locally-adopted building, energy and fire code provisions on achieving the City of Flagstaff's housing affordability and sustainability goals. In addition, recommendations for potential changes or improvements to one or more of these codes are included in this review.

5.2 Analysis Methods Summary

This analysis was informed by a review of the City of Flagstaff's building codes and local amendments, most recently adopted in 2019. These include the 2018 International Building Code (IBC) and the 2018 International Energy Conservation Code (IECC) among others. The City of Flagstaff regularly adopts updates to these codes on a 6-year cycle, so the next update to these codes is expected in the 2024-2025 timeframe. An analysis of potential amendments contemplated under the upcoming local building and energy code updates is not included in this analysis. The Building & Fire Code Analysis was informed by the following:

- Developer stakeholder meetings held in October of 2023. Two meetings were held with stakeholders including developers, engineers, and architects to solicit feedback from members of the local development industry to learn about perceived challenges in the course of designing, permitting and developing residential projects in the City.
- Discussions with City staff.
- A review of development case studies in the City. These are the same projects studies for the overall CAP effort.
- A review and examination of International Building Code (IBC), International Fire Code (IFC), and supplemental City-specific standards by architects, planners, and civil engineers from GBD Architects and DOWL.
- Living unit energy and water modeling, to assess and quantify annual use characteristics and opportunities for affordable ways to improve efficiency and decrease associated carbon emissions.

5.3 Key Findings

5.3.1 Residential Energy and Water Efficiency

GBD examined the 2018 International Energy Conservation Code (IECC), the 2018 International Building Code (IBC), and the 2018 International Residential Code (IRC) Chapter 29 to identify potential barriers to the City's housing and climate goals. Research was conducted that looked at past studies including New Building Institutes' Multifamily Design Guide, Energy Star's

Multifamily Design criteria, U.S. Department of Energy's (DOE) Zero Energy Ready Home Program-Multifamily, as well as the 2018 International Green Construction Code (IGCC).

While the bulk of the code research focused on specific energy issues and related code regulations, the effects of sustainability requirements on housing affordability were also considered. Generally, some increased capital costs in the near term for higher-performance building elements (windows, wall sections, roof treatments, etc.) can be mitigated by the economic benefit of lower energy costs, improving long term affordability outcomes.

Some near-term sustainable building decisions can also be cost-neutral or even more affordable. Improving interior air quality in residential units can be achieved by selecting low-VOC (volatile organic compounds) materials or formaldehyde-free products. Financial incentives may be available from a variety of sources for the specification / incorporation of more energy-efficient elements or systems, potentially improving both near-term and long-term affordability.

Subsequent paragraphs describe other methods of selecting more sustainable and cost-neutral materials. The unit studies outlined below identify some areas that could be targeted for future analysis and/or pilot projects to improve both sustainability and affordability outcomes. In order to establish quantifiable information to be used for the purposes of comparison, modeling was performed on four (4) different dwelling unit sizes ranging from a studio apartment to a 3-bedroom apartment. The focus on apartment-style units is because of the expectation that most affordable housing solutions will likely come from medium to high density multifamily development. The following key areas were studied to better identify and quantify the main drivers of energy and water use:

- Establishing both Energy and Water Use Intensity (EUI and WUI) estimates for each modelled dwelling unit.
- Estimating energy consumption for the following end-uses; heating, cooling, lighting, plug loads and domestic hot water.
- Establishing estimated annual utility cost for assessing economic benefit(s).
- Estimating potential annualized carbon emissions from energy models.

Table 18. Baseline Living Unit Performance Summary

Baseline Energy + Water Consumption Summary by Living Unit

Category	Unit	Studio	1 Bedroom	2 Bedroom	3 Bedroom	Average
Area	*sf*	535	616	895	1,120	792
Energy Use Intensity[1]	*kBtu / sf /yr*	51.1	49.1	48.3	48.8	49.3
Water Use Intensity	*gals / sf / yr*	20.9	21.7	29.6	30.5	25.7
Electricity Use %	*%*	45%	41%	42%	31%	40%

Notes:

1) Based on unit level shoebox energy models that conform to 2018 IECC and ASHRAE 90.1-2016 Appendix G requirements.

2) Utility rates are based on current APS rate tariff residential schedules with an estimated electricity rate of $0.15/kWh and $0.79/Therm.

3) Societal cost of carbon is based on both the Biden's Admininstration current estimate of $51/ton CO2e and climate escalation risk factors based on both EPA and various studies.

4) Water cost is based on current City of Flagstaff 2024 Water and Sewer rates which comes out to roughly $11.51 per 1,000 gals ($0.01151/gal).

Table 19. Relative Baseline End Use Energy Summary by Living Unit

Baseline Energy End Use by Living Unit

End Use	Studio	1 Bedroom	2 Bedroom	3 Bedroom	Average
EUI (kBtu/sf/yr)	**51.1**	**49.1**	**48.3**	**48.8**	**49.3**
Heating	24%	25%	18%	31%	25%
Cooling	4%	3%	3%	3%	3%
Interior Lighting	7%	9%	10%	7%	8%
Exterior Lighting	0%	0%	0%	0%	0%
Interior Equipment	28%	24%	24%	16%	23%
Fans	6%	5%	5%	5%	5%
Pumps	0%	0%	0%	0%	0%
Water Systems	31%	34%	40%	38%	36%

Results from the modeling suggest that the three largest energy uses for all modeled living units are hot water heating, internal appliances/plug use and space heating. Currently, codes only address or regulate minimum efficiencies associated with building envelopes, lighting, heating, ventilation, and air conditioning (HVAC), and hot water systems and do not address standard equipment and appliance loads which are unregulated. Additionally, this study suggests that appliance and general plug-load use are an important component to driving down energy use as it is estimated they represent almost a quarter of a living unit's annual energy consumption. It is expected that as energy codes become more stringent, demanding higher performance and efficiency in lighting and HVAC systems, plug loads could become a greater proportion of residential energy uses.

Due to the fact that many building and fire code provisions related to the required design of structures are state and federal-mandated requirements and the City has little to no allowance to modify these standards, most of the applicable, currently-adopted building and fire code provisions do not present barriers to meeting the City's housing and climate goals. However, when reviewing the template of the applicable structural code provisions in the City, there are opportunities for improving the City's code requirements to prioritize lowering housing related operational costs and furthering the City's climate goals.

In order to improve resilience and further the City's carbon reduction goals, specific attention needs to be given to low to no cost strategies that move beyond current code and permitting requirements. As evidenced by comments received from the LASS-CAP team at the development stakeholder meetings, it is expected that there will be concerns from the development community about the impact of implementing new efficiency requirements on construction costs and housing affordability. However, strategies identified in this memorandum are currently available, well-known and offer solutions that have been proven to be viable and reliable in the marketplace.

The following are some potential code recommendations:

- Consider that applicants submit a Zero Code Tool report as part of the permitting intake and review process (see Appendix 5.1 for an example report). This report is generated online and uses an energy profile data from the 2006 Commercial Buildings Energy Consumption Survey (CBECS) database based on building type, size and location (city and state). The report can provide both applicants and the City an estimation of the potential annualized energy use and the possible renewable energy potential associated

with a design. If tracked appropriately, it could assist the city with understanding the gaps in renewable energy system adoption. For reference, this report is required for all projects in Oregon as part of governor's solar-ready initiative.

- Consideration of adopting IECC 2021 as the base energy code, or at minimum strengthen energy performance in the following areas:
    - Adopt specific building air tightness requirements for dwelling units.
    - Adopt lighting luminaire and lamp efficacy requirements for dwelling units.
    - Require energy recover ventilation for all living units greater than 600 square feet in gross conditioned floor area.
    - Adopt water conservation that specifically applies maximum flow limits on faucets and showerheads, in addition to water closets.
    - Consider requiring Energy Star-rated appliances for all new housing projects. These appliances include refrigerators, dishwashers and in-suite and common use clothes washers and dryers.
- Other examples of potential energy and water efficiency code the City could consider adopting are included in Appendix 5.2.

5.3.2 Solar Readiness

Solar ready provisions are limited in the amended commercial and residential codes. Appendix T of Title 4, Code Section R102 of the International Residential Code (IRC) regulates solar readiness for detached one- and two-family dwellings and townhomes. Other amendments adopted Appendix CA (Solar-Ready Zones for Commercial) for larger commercial structures and have strengthened the code to require solar-ready areas on building rooftops to align better with the City's carbon neutrality goals. These also help address key project outcomes targeting issues including reduced building energy use, carbon dioxide removal, and clean air.

It is important to understand the costs and benefits of solar readiness on residential projects. It is significantly less expensive to plan and incorporate the basic infrastructure needed for solar readiness during building construction than trying to retrofit and accommodate it in the future which could impact viability, even though Flagstaff has very high solar resource potential. As an anecdotal indication of potential local viability, it's worth noting that during the LASS-CAP development stakeholder meetings, multiple developer representatives indicated that they were open to requirements and incentives that made projects "solar-ready."

The consultant team recommends that the City consider adopting solar ready requirements that, at a minimum, address structural capacity to accommodate roof mounted systems, adequate area for renewable system disconnects, breakers and inverter systems, as well as installing proper conduits for easier wiring from roof array to electrical service.

5.3.3 Electric Vehicle (EV) Readiness

The amendment of the 2018 IBC to add Code Section 429 created new requirements for electric vehicle (EV) parking spaces and charging infrastructure. This amendment to the IBC is consistent with similar "EV-friendly" code changes in other cities of Arizona (ex. Tucson, Sedona, Scottsdale) that reflect the evolving electrification of the automobile fleet in the United States. The regulations in Section 429 go beyond the standards in the 2018 IBC and state requirements for number of EV-ready outlets and parking spaces to be supplied for multi-family housing projects. While the current requirements in Flagstaff already exceed the IBC, they could be strengthened to encourage at least two times the current ratios, which would support accelerated build out of EV infrastructure and align with some of the key project outcomes targeting clean air and electric mobility.

There are some challenges to consider with these changes. These could include having adequate electrical capacity on site to support increased amounts of vehicle charging. A related challenge could be meeting code provisions for required amounts of off-street parking while ensuring reasonable access to charging infrastructure. Through stakeholder interviews, the project team heard concerns about how expanded EV-readiness could make residential projects less affordable. Local residential developers flagged increased upfront costs for the new infrastructure not being market-tested or attractive enough to be passed on to potential homebuyers.

The following is a potential recommendation:

- Adopt strengthened EV charging infrastructure installation requirements that increase the ratio of EV parking to standard parking. This will more closely the City with trends in EV ownership and will encourage the shift to cleaner emitting forms of transportation.

5.3.4 Low-Carbon Construction

Currently there are no code provisions that limit the global warming potential (GWP) in any materials especially concrete mixes. Cement production accounts for up to 8% of all global greenhouse gas emissions. Jurisdictions across the country are implementing specific code policy that is addressing and attempting to curb concrete's carbon emissions. Making changes to code to encourage alternatives would be beneficial to desirable outcomes targeting sustainable consumption and the removal of carbon dioxide.

Some implementation challenges could be to overcome general unfamiliarity and uncertainty within the local construction community. There could be concerns about how other building materials could make residential building less affordable. However, other markets such as Seattle, Washington and Portland, Oregon, just as examples, have implemented requirements that have resulted in little to no appreciable cost implications.

The following are some potential code improvement recommendations:

- The identification of global warming potential limits on concrete mixes and structural steel or requiring environmental product declarations (EPDs) to be provided as part of the building permit submission.

- Consider developing a pilot program where City projects are first to employ low-carbon concrete mixes, especially for public facing installations such as sidewalks and curbs to build awareness and familiarity.

- Include allowance for hempcrete based products to be used in residential and light commercial building applications (see Appendix 5.3).

5.3.5 Adaptive Reuse Challenges

Adaptive Reuse and Preservation of Existing Housing Stock is one of the key outcomes addressed in the Code Diagnostic Report. The ability to produce more residential units through the adaptive reuse of existing buildings also impacts several of the project's key outcomes.

GBD has extensive experience adaptively reusing and/or converting certain building types or uses, such as industrial to office, or office to housing. There are a set of practical obstacles that have to be evaluated to assess the success of converting an existing building to another occupancy use. The recent Covid-19 pandemic and its "work-from-home" response has affected demand for office space in many cities across the United States. A reduction in the need for office space could yield potential for more office-to-housing conversions. That said, conversion projects are not without challenges. The following list provides a snapshot of potential obstacles that such a project could face.

- Structural value and capacity to meet current gravity, lateral and seismic code requirements.

- General accessibility and upgrades needed to meet current ADA requirements.

- Determination of adequate means of egress and exiting within the existing building using a higher hazard classification.

- Existing plumbing infrastructure, sizing and capacity to meet a higher fixture and flow count.

- Upgrades to building thermal envelope due to change of occupancy – residential.

- Existing wall conditions to provide adequate ventilation and light via perimeter windows.

- Existing mechanical system's type, age, capacity and routing and if it can be reused in a residential application.

- Existing elevator capacity and sizing – may require upgrade to accommodate gurneys

- Hazardous material risk, exposure and abatement assessment.

5.3.6 Single-Stair Residential Development

There is both national and international interest in promoting and adopting single stair exiting in multifamily housing projects. Extensive study and research have been conducted that allows single stair exiting for certain compact multi-floor housing. This is especially beneficial on narrow or under-utilized lots that are deemed unable to accommodate standard loaded corridors with two stair exits. This opportunity helps open up various lot sizes that would not be suitable for housing with a series of benefits.

This opportunity is already adopted in the City of Seattle where they have adopted point access blocks or single stair exiting as part of the Seattle Building Code (Section 1006.1). As a result, there are a few actual completed projects in Seattle that have used this approach. Currently there are approximately nine other jurisdictions at both the state and city level, including Oregon and the City of Portland, which are exploring or have active plans to adopt a similar allowance or provision into their codes. This opportunity could benefit desired project outcomes addressing compact infill development, lower cost housing production and the creation of a diversity of housing types, among others.

The benefits of allowing a point block access or single stairs range are multifaceted and have potential for bringing lower cost housing into the market. Some of the other established benefits include:

- No decrease in fire and life safety risk.
- Better utilization of smaller lots not suitable for compact housing.
- Lower Embodied Carbon with reduced corridors and stairs.
- Reduced energy footprint with less corridors and stairs.

The following resources and studies go into more depth on the concept of point block access and how it is being implemented throughout the world, along with the known advantages and benefits.

- *https://www.larchlab.com/wp-content/uploads/2022/01/Eliason_CoV-Point-Access-Blocks-report_v1.2.pdf*
- *https://www.centerforbuilding.org/singlestair-tracker*
- *https://www.seattle.gov/documents/Departments/SDCI/Codes/SeattleBuildingCode/2015SBCChapter10.pdf*

5.3.7 Fire Access Standards

Flagstaff Code Title 5 adopts 2018 International Fire Code (IFC) and most of the appendices, including Appendix D – Fire Apparatus Access Requirements. These provisions are not mandatory unless specifically adopted by a jurisdiction, and the City of Flagstaff has voluntarily adopted these standards.

IFC Section 503.2.1 sets a minimum unobstructed fire apparatus access road width of 20 feet. On-street parking is considered an obstruction for fire access, so space within a street cross-section that is dedicated to on-street parking does not count towards the 20-foot fire access width. Appendix D assists in applying this standard, prohibiting parking on roads that are up to 26 feet wide. Roads that are 26 to 32 feet wide may have parking on one side, and roads must be at least 32 feet wide to allow parking on both sides.

In addition to the optional Appendix D standards, the street sections in Title 13 (Flagstaff's engineering standards) indicate "For most situations, fire access has been incorporated into the required street section details of these standards." As discussed in Section 6.2.2 of this report, local residential streets are required to have a width of 33 feet or 37 feet, depending on traffic volume. The fire access width needed for parking on both sides of the street has been incorporated into the required width.

This has helped contribute to wide local residential street sections. As discussed in Section 6.2.2, Section 6.2.3, and Section 4, there may be redundancies in the amount of parking provided on sites and along streets, especially given that on-street parking is always required on local streets but cannot be used overnight for much of the year given the Winter Parking Ordinance. With underutilized on-street parking flanking both sides of every new local street, these streets are land-consumptive and contribute to a conventional suburban development pattern that is based around the needs of vehicles. These patterns conflict with City housing and climate goals including abundant housing supply, lower cost housing, infill development, and generally more compact land use that supports infrastructure efficiency and sustainable modes of transportation.

Appendix D, Section D105 provides standards for when ladder / aerial apparatus access is required for a building with a roof height exceeding 30 feet. This may apply to local streets or driveway aisles such as within multifamily or commercial development sites. Aerial access must be accommodated along one entire side of proposed buildings exceeding 30 feet, within between 15 and 30 feet of the building. The aerial access drive must have a minimum unobstructed width of 26 feet and have no overhead obstruction such as power lines.

The way that the Appendix D standards have been adopted, incorporated into City engineering standards, and the subsequent implementation of these combined standards has resulted in a system that may be inflexible to unique site considerations. Development stakeholders have expressed concern that wider access drives to meet aerial apparatus widths may have been requested in instances when they did not seem to be needed based on code, so more collaborative discussions are desired to help clarify what is needed, the safety reasons why, and how to achieve safety accommodations within the site design.

The following may help mitigate potential tensions between fire access and affordability and sustainability goals:

- Consider de-coupling street standards from fire access standards. Both engineering standards and fire access standards and reviews will be required regardless, but there may be instances where it is a disadvantage to have the standards combined, especially if local street standards are considered for code modifications such as reducing or allowing flexibility with on-street parking requirements.

- For streets with medians, consider allowing removal of the median to help meet the minimum fire access width requirements in a narrower roadway width, also permitting quicker emergency response.

- Consider adding stipulations to the engineering standard modification process to help resolve situations where specific constraints on a site may make it difficult to meet other requirements in combination with fire access requirements. Other design standards (not fire access standards) could need to bend in certain situations.

- In other very limited situations, site constraints may be such that it is extremely difficult to meet exact fire access standards as written in Appendix D. The fire department could choose to exercise discretion and work with a development team to find a site-specific way to meet safe site access needs. For example:

    - Aerial apparatus access width or truck turning radii may be challenging for infill development; this may discourage higher density infill development. In some other jurisdictions, the following are examples of how fire departments are able to address this challenge:

        - If aerial apparatus access can't be provided along one full side of a building within the range of separation from the building, reviewers may be able to approve an acceptable alternative in which aerial apparatus access could be provided along portions of multiple sides of the building.

        - In some jurisdictions, fire departments have special smaller vehicles that can maneuver in areas like older downtowns, where streets may have been built according to older and narrower standards.

    - The location of secondary access can be a major challenge for some developments based on topography or other site constraints. Allowing flexibility that still meets City safety needs could help encourage developers to plan more units in new subdivisions or multifamily developments rather than decrease units to avoid secondary access requirements. The following are examples of how some other jurisdictions' fire departments are able to address this challenge:

        - The code requires that "where two fire apparatus access roads are required, they shall be placed a distance apart equal to not less than one half of the length of the maximum overall diagonal dimension of the lot or area to be served, measured in a straight line between accesses." This is very specific and may be extremely challenging in some site design situations. The fire department could choose to exercise discretion in light of these challenges as long as means of access are provided that the fire department has determined will be adequate.

        - In some jurisdictions, fire departments have special vehicles that can maneuver on more steep or otherwise topographically challenging roads.

Through more understanding and collaboration between Planning, Engineering, and Fire departments and divisions at the City, there may be neighborhood or site-specific solutions to ensure safety needs, alongside housing and climate goals, can all be advanced through design requirements.

5.3.8 Fire Protection Water Supply

Engineering design standards for water infrastructure outlined in FCC Title 13 (as discussed in Section 6 of this report) require water mains to be 8 inches wide. However, several areas of Flagstaff have older infrastructure that includes 6-inch mains. This was considered adequate in the past, and it is important to note that only 6-inch lines are required to serve fire hydrants.

Requiring 8-inch water mains presents a barrier to affordable housing development in areas that are currently served by 6-inch mains, as well as more compact and infill development. City staff has indicated that there are no current plans to update these older water mains in most locations. Therefore, property owners or developers would have to take on significant cost to update infrastructure in the area of their development. This discourages higher density redevelopment, which is a barrier to key City housing and climate outcomes.

This is especially a missed opportunity in and around downtown Flagstaff, where older 6-inch water mains exist in many areas. Infill development that could otherwise occur in these traditional downtown neighborhoods would be well-aligned with City goals of compact and mixed-use neighborhoods that support sustainable modes of transportation.

The requirement for 8-inch mains may not always be necessary as long as minimum fire flows for buildings are met. This ranges from 1,000 gallons per minute to 8,000 gallons per minute based on building size and construction type. If minimum fire flow for current and proposed buildings in an area can be met with 6-inch mains, this should be considered as an option.

To facilitate desired higher density development, including when an update from a 6-inch to an 8-inch main is needed based on fire flows, the City could consider completing area-wide WSIAs and potential capital improvement projects or cost sharing for infrastructure upgrades, given that the higher-density development is an important step towards City housing and climate goals.

5.4 Other Considerations

Feedback from the development stakeholder meetings suggested that the primary barrier preventing projects from adopting sustainable design features is the perception that it adds cost to developers, building owners and financiers. The development community appears to view sustainability features as a ‘nice to have’ aspect, not a ‘need to have.’ Sustainability features are not viewed as imperative or even prudent investments, especially with all of the macro-economic forces that are currently challenging and influencing planning, design and construction decisions. However, there are opportunities to focus on how housing affordability and sustainability go hand-in-hand:

- There are building materials and systems that are more sustainable and efficient that do not necessarily add significant building or operations costs. These may include using more salvaged or reclaimed materials, or selecting materials that are certified as limiting or not containing chemicals such as added-urea formaldehyde or have low VOCs as defined by a certification testing body such as California’s Department of Public Health (CDPH) Standard Method v1.2.- 2017.

- Incorporating energy efficiency features from the beginning of the development lowers utility bills which leads to lower monthly housing costs.

- Forgoing natural gas infrastructure can result in significant savings at the site level.
- There are federal and other incentives to offset the upfront costs of installing high-efficiency and all-electric appliances, heating/cooling systems, and building materials.

Accomplishing carbon neutrality will involve consistent community engagement and education of the public on the purpose and benefits of sustainable design, raising the bar on new and existing building energy performance while also encouraging and regulating lower embodied carbon building materials across all product segments. If implemented in a mindful and strategic way, then reaching carbon reduction milestones will become easier and commonplace as public know-how and acceptance grows. This may also help reduce the perception of sustainability features as ‘nice to have’ associated mostly with luxury residential products and encourage more widespread use and access to long-term cost savings they can provide.

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT– DEVELOPMENT CODE DIAGNOSIS

ENGINEERING
CODE ANALYSIS

6

DOWL

6.0 ENGINEERING CODE ANALYSIS

6.1 Introduction

6.1.1 Analysis Purpose

The purpose of this analysis is to examine and discuss aspects of the City of Flagstaff's engineering and transportation impact analysis requirements that could be modified to better achieve the City's desired housing production, housing affordability, and carbon neutrality outcomes.

As discussed in Section 4 of this report, the City's Zoning and Subdivision standards bear the most influence on the production and form of housing and other development in the City; therefore, changes to zoning or subdivision standards may have the most potential to directly impact housing production and neighborhood density. Greater housing production and density in an urban context that can be better served by transit and provide non-vehicular access to services also support sustainable transportation and other carbon neutrality outcomes.

In addition, the engineering standards that govern infrastructure design, including transportation and utilities, also play a role in development density, cost, and suitability for sustainable modes of transportation. Infrastructure design can also be subject to many of the same potential co-benefits and/or tensions of housing and climate priorities. This analysis uses a similar framework to Section 4 to discuss potential barriers related to water, sewer, stormwater, and transportation in Flagstaff.

6.1.2 Methods

DOWL's analysis of engineering standards was informed from the following procedural steps:

- Developer stakeholder meetings held in October of 2023. The project team facilitated two meetings with developer stakeholders to solicit feedback from members of the development industry in Flagstaff regarding challenges encountered in the course of designing, permitting and developing residential projects in the City.

- Meetings with City staff, including site visits, during November of 2023.

- A review of development case studies in the City. These are the same projects studied for the overall Code Analysis Project (CAP) effort.

- A review and examination of Flagstaff City Code (FCC), standards, and processes by DOWL planning and engineering staff:
    - Title 8 – Public Ways and Property
    - Title 13 – Engineering Standards and Specifications for New Infrastructure
    - Transportation Impact Analysis Manual
    - Stormwater Manual and Low Impact Development Guidelines

The results of DOWL's analysis have been reported in this document, which identifies potential areas of improvement within the City's engineering and transportation codes and procedures for consideration in future code improvement projects.

6.1.3 Development Community Input Summary

The following is a summary of key topics related to engineering design standards that development stakeholders noted as challenges to achieving affordability and sustainability with residential development. These topics were used to help inform which sections of code were more closely examined in the engineering code review process.

General Land Development Costs

Development stakeholders commented that much of the available land in Flagstaff contains environmental constraints that can make development more costly, such as steep slopes or floodplain areas. However, it was noted that the most significant cost to development—even more than the cost of land—is the cost associated with upgrading and extending infrastructure to serve development sites. Developers suggested that the City focus on allowing maximum flexibility in infrastructure design solutions to enable developers to find solutions that adapt to unique site constraints and lower development costs.

Impact Analysis Review Processes

Developers indicated that review processes for design and impact analyses could benefit from streamlining and changes. For example, it was suggested that Water and Sewer Impact Analyses (WSIAs) and Transportation Impact Analyses (TIAs) are required very early in the entitlement process, before the development program is fully defined. Extensive time and money are spent preparing analyses that may be premature and require significant changes later. The cost, extent, and phasing of mitigation that may be required can significantly vary project by project, creating unpredictability of cost and schedule impacts. Anecdotally, multiple stakeholders noted instances in which developers scaled back the extent of residential units to avoid triggering impact analyses and the potential mitigation that might be triggered.

There is a perception that offsite mitigation gets pushed onto larger projects, rather than being shared more equitably between benefiting developments and the City; this impacts larger developments' ability to achieve more affordability through economies of scale. Multiple members of the development stakeholder group suggested that having "impact fees" or traffic system development charges (SDCs) and a more robust capital facilities program funded by the SDCs would be a more financially reliable and equitable approach to addressing a project's traffic impacts.

Utility Infrastructure

Many development stakeholders mentioned that bringing infrastructure to a development site is a significant portion of the cost to develop and a significant contributing factor to high housing costs. Stakeholders suggested that the City could provide more water and sewer information publicly and allow developers to complete their own WSIA to potentially save time and cost. Stakeholders also discussed a need to clarify when it may be appropriate for the City to participate in updating outdated or undersized infrastructure as opposed to developers, depending on development capacity needs and/or known issues with water and sewer systems. Easements, water meters, and potential private utility infrastructure serving multifamily developments were also cited as areas requiring closer examination and discussion.

Stormwater Infrastructure

Stakeholders provided input regarding the impacts of different stormwater management requirements on development. Much of this information was anecdotal and ranged from comments that the facilities are failing in certain large storm events to suggestions that the facilities are overbuilt based on overly conservative design assumptions.

Other stakeholders commented that Low Impact Development (LID) standards should be eliminated, noting that there are no critical waterways and most sediment and debris gets settled out in detention basins anyway. It was noted that prevalent soils in the area often don't drain well, so underdrains are often required anyway, resulting in greater project expense. Development stakeholders indicated other City guidelines for locations of storm facilities may be pushed onto development, adding additional expense when developers might have other ideas that meet stormwater management needs and safety and aesthetic goals; more design flexibility may need to be accommodated.

Transportation Infrastructure

Stakeholders discussed concerns with what they perceived as excessive road cross section requirements. There is a desire for narrower streets and reduced sidewalk and planter strip design options in some cases to decrease cost impacts of wide rights-of-way (ROW), particularly on local streets and for infill development; this could potentially be achieved through design standard revisions or a clearer path for obtaining approval to modify standards. Collector and arterial streets may also present opportunities for reduced or re-prioritized cross-sections, which could particularly support carbon neutrality and sustainable transportation goals.

Developers indicated that existing requirements for access and street frontage improvements may discourage redevelopment and lead developers to decrease units for large new developments to avoid certain requirements. Some of the road design standards may encourage sprawling and disconnected development patterns with faster vehicular travel, despite goals of promoting safe access for active modes of transportation.

Modifications and Conflicting Priorities

There is a process for engineering standard modifications defined in code.[14] Some development stakeholders indicated that the process may be inconsistently implemented, or City staff may be hesitant to approve modifications. It may be possible to revise code to clarify parameters on when the City can approve modifications to standards.

However, City staff has indicated that changes to the engineering standards themselves would result in more consistent application of standards (as opposed to approving more modifications). As discussed throughout this analysis, engineering standards could be modified to facilitate designs that decrease housing cost and carbon emissions, better aligning with City development goals.

[14] Flagstaff City Code, Section 13-06-002-0001.1.1.

6.1.4 Application of Key Housing and Climate Outcomes

Tables 2.1 and 2.2 in Section 3 of the main body of this report provide the list of key outcomes that were derived from the planning documents related to housing and climate change, respectively. As discussed in Section 3, the tables identify and describe each desired outcome. The same key outcome tables and analysis framework applied in Section 4 of this report have been applied within this Section 6. The result is a diagnosis of potential barriers and/or opportunities to improve engineering standards and review processes in the context of housing and climate goals.

As with zoning and subdivision considerations, some engineering standards or processes may impact both housing and climate outcomes, sometimes including tensions or tradeoffs. Each time an element of code or process is identified as a potential barrier or issue, this analysis uses a matrix to identify which specific outcomes are impacted, and to what degree (critical, major, minor, or not applicable). Some sections of the engineering standards were not deemed critical barriers to housing and sustainability goals; these are discussed in Tables 23, 24, and 25.

This approach ensures a holistic evaluation in which all relevant outcomes are considered for each regulation. This also enables the City to identify when a desired outcome is affected by multiple, separate code regulations or elements of engineering review processes, which may have a compounding effect on the ability of the City to achieve that outcome.

Figure 10. East JW Powell Boulevard

Photo of a recently constructed roadway in Flagstaff – East JW Powell Boulevard, a minor arterial.

6.2 Transportation Design and Access

6.2.1 Collectors and Arterials

6.2.1.1 Summary

Major arterial, minor arterial, and major collector functional street classifications support vehicle-focused development patterns. Vehicle design speeds for these facilities are at least 35 to 40 miles per hour, ROWs are wide (ranging between 92 and 98 feet) with up to four through lanes plus a median / auxiliary lane(s), and these facilities currently may not adequately consider safety or convenient access for public transportation or active modes of transportation in their cross-sections.

These major streets are expensive to build and maintain, and given their designed intent of facilitating vehicular throughput, they do not advance climate goals such as compact land development and sustainable transportation networks. Based on DOWL's review of traffic volumes experienced on the City's collector and arterial network as described below, fewer through lanes and lower speeds would be adequate to meet traffic needs on the vast majority of Flagstaff city streets and could help support a push towards public transportation and active modes of transportation.

6.2.1.2 Impact on Key Outcomes

HOUSING		**CLIMATE**	
🔵	Abundant Housing Supply	🔴	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🔵	Lower Cost Market Rate Housing	🟠	Electric Mobility
🔵	Income-Restricted Affordable Housing	⚪	Energy
🔵	Mixed Use Development and Neighborhoods	⚪	Waste and Water
🟠	Infill Development and Compact Land Use	⚪	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

6.2.1.3 Code Section(s)

- Table 13-10-011-01
- 13-10-014

6.2.1.4 Analysis of Issues and Impacts

The Highway Capacity Manual (HCM), published by the national Transportation Research Board, uses traffic data to set industry-standard “theoretical maximums” for Average Daily Traffic (ADT) that can be accommodated on roads based on number of vehicular travel lanes. According to the HCM, three-lane cross-sections (one lane in either direction with a third lane for turning traffic) can accommodate a maximum ADT of around 18,000 to 19,000. In Flagstaff, this is most similar to the Minor Collector cross-section outlined in Title 13.

Only 16 of over 260 segments of Flagstaff streets where 2023 traffic data was collected were found to have ADT exceeding 18,000, on sections of just four different streets (North Cummings Street, East Butler Avenue, North Fourth Street, and East Forest Avenue). Based on the current traffic data, the vast majority of Flagstaff streets’ current traffic could be accommodated with Minor Collector cross-sections, or three vehicular travel lanes or less.

The HCM considers an ADT of around 38,000 to be the theoretical maximum for five-lane roads. Only four of the over 260 segments of Flagstaff streets measured in 2023 traffic data exceed this ADT, all located on North Cummings Street by the Flagstaff Mall. However, as show on the Roadway Functional Classification Map adopted as part of Title 13 as Figure 13-10-014-0003 (Figure 11 below), there are many more streets identified as current or future major collectors or arterials. Some of these are state roads, over which the City does not have jurisdiction, but many are City routes that can be planned and designed according to City transportation priorities.

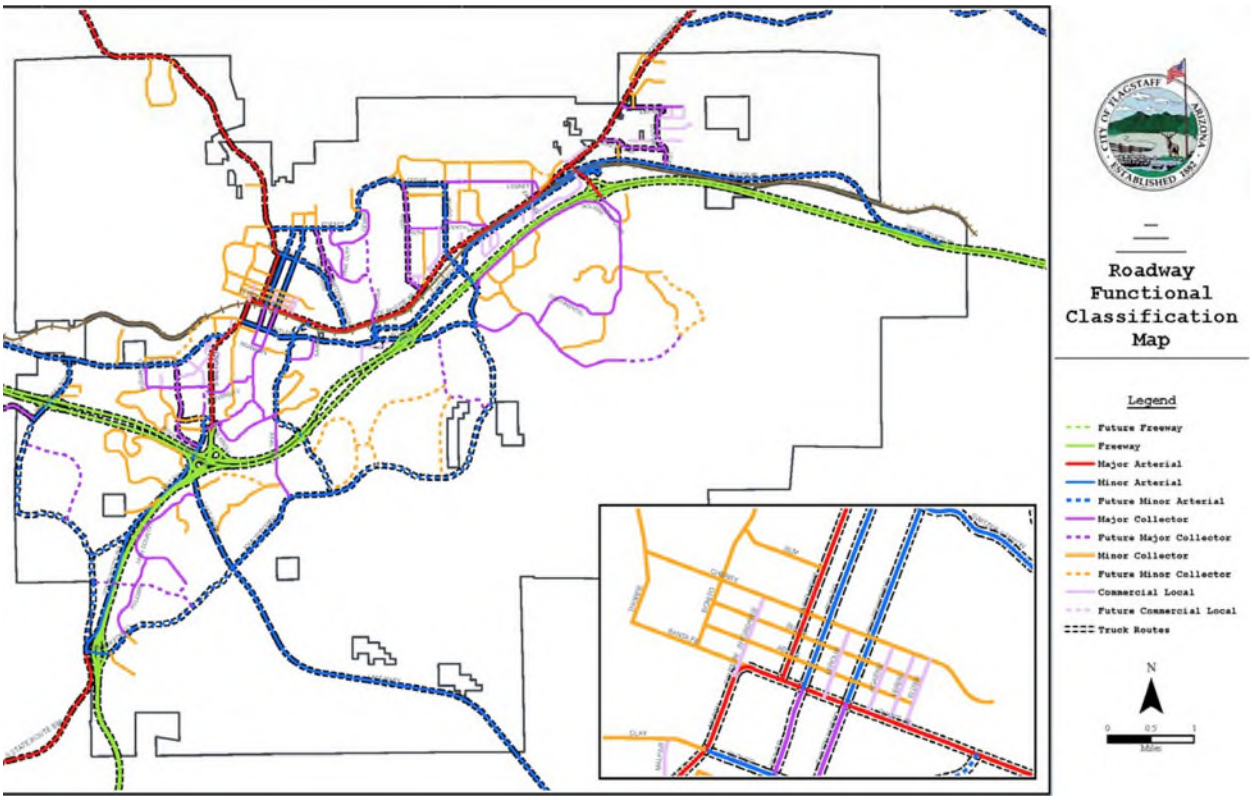
Existing designated major arterials include portions of State Route 89A, South Milton Road, East Route 66, North Humphreys Street, Fort Valley Road, North Highway 89, and U.S. Route 180. There are no future major arterials designated at this time.

Existing designated minor arterials include portions of State Route 89A, South Beulah Boulevard, South Woody Mountain Road, West Route 66, JW Powell Boulevard, Lake Mary Road, South Lone Tree Road, East Butler Avenue, North Beaver Street, North San Francisco Street, West Columbus Drive, North Switzer Canyon Drive, West Forest Avenue, East Cedar Avenue, North Fourth Street, East Huntington Drive, East Industrial Drive, East Nestle Purina Avenue, and Historic Route 66. Future minor arterials include portions of South Woody Mountain Road, JW Powell Boulevard, and other road extensions or new roadways that do not yet exist.

Existing designated major collectors include portions of South Flagstaff Ranch Road, West Kiltie Lane, South Pulliam Drive, High Country Trail, South Woodlands Village Boulevard, West University Avenue, South Beulah Boulevard, South Thompson Street, University Drive East, West McConnell Drive, East Pine Knoll Drive, South San Francisco Street, North San Francisco Street, South Beaver Street, North Beaver Street, South Lone Tree Road, East Sawmill Road, North Turquoise Drive, East Ponderosa Parkway, North Pine Cliff Drive, North Gemini Road, East Arrowhead Avenue, North Izabel Street, East 6th Avenue, East 7th Avenue, East Lockett Road, North Fanning Drive, East Butler Avenue, North Continental Drive, North Country Club

Drive, East Soliere Avenue, East Marketplace Drive, Test Drive, North Dodge Avenue, and East Empire Avenue. Future major collectors include portions of South Beulah Boulevard, Ponderosa Parkway, and other road extensions or new roadways that do not yet exist.

Figure 11. Roadway Functional Classification Map



Minor collectors have a minimum ROW width of 70 feet, whereas major collectors must be 92 feet or wider in some cases and arterials must be at least 98 feet, which is 40 percent wider than minor collectors. Designating streets as these higher classifications establishes very wide roadway widths that, when implemented, would result in a more land consumptive and costly infrastructure network, representing barriers to City housing and climate goals.

More space dedicated to vehicles results in less land available for housing, creates more roadway maintenance, and creates more separation between neighborhoods. Due to the increased speeds of travel and the greater distances for crossings, major collectors and arterials are less safe to cross for people traveling by active modes of transportation or accessing transit stops, as compared to narrower streets with slower vehicular speeds. These factors also make travel by personal vehicle more convenient than transit or active modes.

Below is a summary of key widths and requirements for major street functional classifications as listed in Table 13-10-011-01 in Title 13. (Standard details are also shown in Details 10-09-032 through 10-09-035 for the cross-sections listed below in Table 20).

Table 20. Collector and Arterial Street Design Requirements

URBAN Street Types:	Major Arterial	Minor Arterial	Major Collector	Minor Collector
Design Speed	45 mph	40 mph	35-40 mph	30 mph
Minimum ROW Width	98’	98’	92’ or 96’	70’
Width (Back of Curb to Back of Curb)	72’	72’	68’ or 72’	46’
Max Through Lanes	4	4	4	2
Through Lane Width	12’	12’	11’ or 12’	11’
Minimum Median Width	15’	15’	15’	NA
Auxiliary Lane Width	11’	11’	11’	11’
On Street Parking	Not allowed	Not allowed	Not allowed	Not allowed
Bicycle Provision	4.5’	4.5’	4.5’	4.5’
Minimum Parkway	5’	5’	5’	5’
Minimum Sidewalk	6’	6’	5’	5’

In potential code revisions and/or in proposed roadway design reviews, the City could consider prioritizing safety, noise, space, active modes of transportation goals according to the Active Transportation Master Plan (ATMP), transit guidelines according to Mountain Line’s 2023 Flagstaff in Motion: A Community Transit Plan, and other impacts associated with larger roadways such as major collectors and arterials. When major collectors or arterials (with four or five lanes) are determined to be needed based on current or projected traffic, the City could consider the following adjustments to re-prioritize space for sustainable modes of transportation:

- Decrease speed limits and utilize traffic calming strategies.
- Decrease through lane widths to 11 feet (when possible) to encourage lower vehicular speeds and use less space.
- Decrease median widths from 15 feet to 11 feet to match through lane and auxiliary lane widths.
- Use extra space to widen sidewalks and/or bicycle provisions.
- Prioritize safe crossings for people walking, bicycling, or rolling at intersections and particularly around public transportation networks.

The following shifts and re-prioritizations could be considered in order to encourage street design to better align with City goals:

- Avoid classifying current or future roads as major collectors or arterials (four or five lanes) if ADT could be accommodated with a minor collector (two or three lanes). Use planning documents such as the Regional Plan, a revised version of the Roadway Functional Classification Map, or potentially a new Streets Master Plan to make this shift.
- Where four or five lane major collectors or arterials are already constructed, assess traffic conditions and consider “road diets,” or decreasing the number of vehicular travel

lanes and rededicating the additional ROW to bus only lanes, wider sidewalks, bicycle infrastructure, Flagstaff Urban Trails System (FUTS) extensions, or pedestrian realm amenities along roadways. These features can be coordinated according to the ATMP and with Mountain Line.

- Consider implementing roundabouts or coordinated signal corridors to manage intersections on higher-traffic minor collectors.

- Design transportation infrastructure to prioritize transit efficiency and safety, such as in-lane bus stops rather than pull-outs, bus only lanes, or queue jumps.

6.2.1.5 Co-Benefits of Addressing the Barrier

The City's major collector and arterial design standards are not as compact or efficient as they can be given the traffic volumes that they experience. Additionally, the travel speeds that they are designed to accommodate indicate a priority for vehicles over transit and active modes of transportation. Therefore, these sections conflict with key climate outcomes, especially Community Resilience, Health and Safety and Sustainable Transportation Networks and Neighborhoods. Thinking critically before dedicating new major collectors and arterials, pursuing road diets, generally slowing vehicles and decreasing space dedicated to fast vehicular movement, and re-prioritizing infrastructure for active modes when designing major roads would create a safer and more comfortable environment for people to choose transit or active modes of transportation. While helping reduce carbon emissions, this change could also lower cost of living and encourage walkable and mixed-use neighborhoods with amenities near housing.

6.2.1.6 Tensions with Other Policy Goals

There is a tension between prioritizing fast and uninterrupted movement of vehicles versus prioritizing some aspects of City housing and climate goals. Dedicating space to more sustainable modes of transportation (such as transit or active modes) without widening streets requires re-prioritization of streets and making some compromises. There could be a perception that this change worsens vehicular traffic if people are accustomed to driving on wide, vehicle-oriented roads, and there would likely be a transition period before improved transit and active mode facilities can take some pressure off vehicular traffic. However, moving away from wide roads built for high vehicle design speeds would help advance the City towards greater consistency with its climate goals.

6.2.2 *Local Streets*

6.2.2.1 *Summary*

Relatively wide local street cross-sections can represent a significant cost burden for new subdivision development, both through the cost for infrastructure itself and the land that could otherwise be developed as more housing. This makes development less compact and can encourage faster vehicular speeds, making neighborhoods less safe for active modes of transportation. Redevelopment to meet current street standards, including frontage requirements, could also be a barrier to infill development. These vehicle-focused and low-density development patterns do not advance housing or climate goals.

6.2.2.2 *Impact on Key Outcomes*

HOUSING		**CLIMATE**	
🔴	Abundant Housing Supply	🟠	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🟠	Lower Cost Market Rate Housing	🟠	Electric Mobility
🟠	Income-Restricted Affordable Housing	⚪	Energy
🔵	Mixed Use Development and Neighborhoods	⚪	Waste and Water
🔴	Infill Development and Compact Land Use	⚪	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

6.2.2.3 *Code Section(s)*

- 13-10-001 through 13-10-011
- 13-10-012

6.2.2.4 Analysis of Issues and Impacts

Chapter 13-10, Streets provides requirements for the design of all new or reconstructed streets, based on functional classification (defined in 13-10-014) and the volume and character of the projected traffic. This chapter of code is extensive and complex. There are different local street standards for urban versus rural neighborhoods, with narrower and wider options depending on traffic. These local streets are typically used to access residential properties in neighborhoods classified as "conventional suburban developments." The name itself suggests development patterns that are low-density and vehicle-oriented, which does not align with the City's housing and climate goals.

Alternative standards exist for streets that are called "thoroughfares" in traditional neighborhood districts (TND) which have separate design standards in Section 13-10-012. These may be more oriented towards context-sensitive design and compact development that support sustainable modes of transportation in line with the City's housing and climate goals, but these standards have almost never been used and are written in a complex and theoretical way, potentially making them too confusing and unapproachable to attempt. These alternative standards are discussed further in Section 6.2.7, Additional Minor Barriers and Issues.

The focus in this section is on the more common local street types that tend to be located throughout residential neighborhoods in Flagstaff (not TND thoroughfares, rural roads, or more major functional classifications discussion in Section 6.2.1). Urban residential local streets typically have design speeds of 20 miles per hour, with space for two vehicular travel lanes. These have been compared to other lower-traffic street types, Commercial Local and Minor Collector, in the table below as summarized from FCC Table 13-10-011-01.

Table 21. Local Street Design Requirements

URBAN Street Types:	Minor Collector	Commercial Local	Residential Local "Wide"	Residential Local
Maximum ADT			1000	500
Design Speed	30 mph	25 mph	20 mph	20 mph
Minimum ROW Width	70'	52'	61'	57'
Width (Back of Curb to Back of Curb)	46'	28'	37'	33'
Total Asphalt Width	42'	24'	33'	29'
Through Lane Width	11'	12'	N/A	N/A
Auxiliary Lane Width	11'	N/A	N/A	N/A
On Street Parking	Not allowed	Not allowed	Not striped	Not striped
Bicycle Provision	4.5'	In travel lane	In travel lane	In travel lane
Minimum Parkway	5'	5'	5'	5'
Minimum Sidewalk	5'	5'	5'	5'

(Also see Details 10-09-035 through 10-09-038 for the above Urban street cross-sections.)

For reference, an ADT of 500 is what would be estimated for a street providing access to approximately 52 single-family homes. For streets accessing more homes, local "wide" standards are required. For streets with ADT over 1000, an even wider and faster minor collector could be required. As previously noted in Section 6.2.1, the HCM determined the

theoretical maximum of cross sections similar to minor collectors to be 18,000 to 19,000 ADT. This is a major jump in ADT between what is allowed to be a local street versus a minor collector, and it is brings on a higher speed limit and about 10 additional feet of ROW width.

Needing to dedicate additional ROW could be a deterrent to higher density new development or redevelopment, including multifamily residential development. More land-consumptive road designs take away land that could otherwise be utilized for more housing and result in higher infrastructure costs for wider streets. These costs are typically ultimately transferred from developers to residents, representing an additional housing cost burden.

As shown in the tables above, approximately 10 to 12 feet could be provided for travel lanes, therefore requiring only about 24 feet of asphalt for two-way streets. For fire access under current code, either 20 or 26 feet of width is needed. However, 29 or 33 feet of asphalt is provided for narrower and “wide” local cross-sections in urban areas, some of which is envisioned for on-street parking (not striped), flanked by around 14 feet on each side of the road for curb and gutter, parkway landscaping, sidewalk, and additional buffer space.

Under current zoning code, off-street parking is required and encouraged. As discussed in Section 6.2.3, the Winter Parking Ordinance prohibits overnight on-street parking during the winter months, regardless of snow conditions. In total, City staff and development stakeholders reported observations that there is more space dedicated to vehicle parking than is needed or used. As a result, City staff and development stakeholders reported that the unstriped on-street parking along both sides of residential streets often sits empty as residents and visitors park in garages and off-street driveways.

Wider roads create a sense of comfort for drivers and contribute to higher vehicle speeds. With vehicles typically not parked along local streets, drivers essentially have space that is 14.5 to 16.5 feet wide, which is much wider than 12-foot lanes on high-speed roads like highways. Some of this space is expected to be shared by cyclists, but elevated vehicular speeds and lack of striping or protection for cyclists impinges on cyclist comfort and may discourage cycling on the roads.

Traffic calming is stated as a priority in Section 13-10-002-0001.E:

> *“Require that new designs incorporate traffic calming techniques into all new residential streets. The goal is to reduce residential traffic speeds to within the design speed limits, while maintaining safe and reasonable access for all intended normal traffic. In order to achieve this objective, the maximum length of a roadway section between speed control points shall be six hundred sixty (660) feet…”*

Table 13-10-011-02 provides a list of over a dozen traffic calming measures, but does not discuss the traffic calming effect of simply using a narrower asphalt width. Almost all of the measures in the table involve design, construction, and maintenance costs associated with unique elements in the ROW, requiring additional dedication of land and development cost. The traffic calming requirements at regular intervals may also decrease vehicular access and connectivity for residents, emergency responders, and other service providers. There is minimal guidance in code about when the different traffic calming features should be used and in what context they are most appropriate.

Beyond wide spaces dedicated to vehicles, parkways and sidewalks add to the expense associated with new or upgraded street development, which translates into additional space that

cannot be developed as housing and additional infrastructure cost that contributes to housing cost. However, these spaces are particularly necessary when other aspects of road design contribute to high vehicle speeds and unsafe conditions for active transportation. They also offset snow storage and drainage needs associated with streets.

As discussed, wide ROWs reduce available land for housing and add development expense. Additionally, by encouraging higher travel speeds, safety can be impacted for active modes of transportation and for access to transit. Thus, these conditions all conflict with City housing and climate goals. Local street standards should be re-examined; the following are some potential re-prioritizations and/or code changes to consider:

- As discussed in Section 6.2.1, there may be misalignment between perceptions of traffic volumes versus actual ADT different roadway cross-sections can accommodate. Consider clarifying and adjusting thresholds to avoid upsizing cross-sections unless necessary for safety (traffic calming is a desired outcome).

- Do not provide wider asphalt width than is needed for fire access on local roads.

- As part of broader consideration of reducing on-site vehicular parking requirements and the Winter Parking Ordinance discussed in Section 6.2.3, consider whether it is still necessary to dedicate space to on-street parking on both sides of local streets, especially given City and development stakeholder observations of current low utilization.

    - Removing space dedicated to on-street parking could drastically reduce perceived width of ROWs, slowing vehicular speeds.

    - Consider striping bike lanes on at least one side of existing streets with space dedicated to on-street parking. This would be easier to implement than major redesign of existing ROWs and could help initiate a shift towards prioritizing active modes of transportation.

- Reconsider queuing streets (narrower width with on-street parking) that were allowed in the past but removed from the engineering standards, or similar design concepts such as Woonerf streets.

    - Some aspects of the TND thoroughfare design standards may be able to be incorporated into street standards to help them be more appropriate and responsive to neighborhood context.

- Consider whether narrower parkways could accommodate City sidewalk buffer and snow storage needs on local streets. This change could help allow more space for wider sidewalks and/or multi-use separated pathway on one or both sides of the street. The ATMP could help guide priorities and where different types of facilities should be designed.

- Outside of street design standards, front setbacks in residential neighborhoods could be decreased to assist with decreasing the perceived width of the street that encourages higher vehicle speeds.

- The City could consider examining pros and cons of street and site design patterns in local neighborhoods that are regarded to have compact development and/or narrower streets, such as Presidio or Ponderosa Trails, to find potential best practices.

6.2.2.5 Co-Benefits of Addressing the Barrier

Narrower ROWs would allow more space to be used for housing and less to be used for roads. This, in combination with zoning code changes to allow greater density, would promote a more compact development pattern that allows developers to plan projects that are lower cost due to economy of scale.

Less asphalt is also less space that needs to be cleared of snow and less impervious surface that needs to drain; narrower roads can make neighborhoods more resilient. More efficient infrastructure and land use lowers costs for residential development and allows more units to be built.

Narrower streets shorten crossing distances for active modes of transportation, and traffic calming improves safety and comfort for active modes. This could help encourage active modes, transit, or other micro-mobility options.

6.2.2.6 Tensions with Other Policy Goals

Some street width is necessary based on fire access requirements. This is discussed further in the Fire Code Analysis in Section 5 of this report. Any changes to this section will need to be vetted for safety impacts including emergency access.

It is important that the potential removal of on-street parking space be considered alongside other potential parking changes in zoning code; decreasing roadway widths coupled with decreasing setbacks and/or decreasing or removing on-site parking requirements could create parking challenges, especially for developments in areas farther from urban centers that are car dependent by nature of their location.

Some developers hope to save costs by designing streets without some of the pedestrian amenities including sidewalks or parkways. In neighborhoods that are lower density and more rural in nature, active modes share the street with vehicles. However, these lower-density neighborhoods are not aligned with City housing or climate goals, and removing sidewalks is not aligned with goals in the ATMP. Parkways can be an attractive neighborhood feature that buffer sidewalks from vehicles and provide space for snow storage that doesn't bury sidewalks and block all-season sidewalk access. Removing space dedicated to vehicles would be more aligned with City policy goals, as opposed to removing space dedicated to sustainable modes of transportation.

Under current code or potential future code changes, there could still be unforeseen circumstances or unique ideas that arise that may lead a developer to want to pursue different street design standards. In some multifamily developments in particular, there may be alternatives to on-street sidewalks for pedestrian accommodation, but the City has no standards or guidelines for this. There is a modification process in code, but cost is not an approval consideration and developers have indicated that City staff may be hesitant to approve modifications. To allow flexibility with parameters, the City may consider incorporating housing and climate goals into the modification justification and review process.

Private streets are not typically developed because they have to meet public street standards, which negates any potential cost savings a developer may be seeking. Cost is transferred to residents the same as public street development costs would be in a new subdivision, only the residents would also end up paying additional fees for maintenance and snow plowing, creating further affordability concerns.

6.2.3 *Winter Parking Ordinance*

6.2.3.1 *Summary*

Overnight street parking is prohibited for five months each year in case snow plowing is required, even if there is no snow (with a few streets excepted). Based on current zoning code, residential developments must provide adequate parking on site. As discussed in Section 6.2.2, most Flagstaff streets are currently designed to accommodate on-street parking. The combination of on-site and on-street parking at roughly doubles the amount of impervious surface dedicated to parking vehicles, making development less dense which has critical negative impacts to both housing affordability and sustainability.

This issue severely limits compact urban development, including mixed-use development, infill development in the downtown area or other activity centers, small multifamily developments, and development of Accessory Dwelling Units (ADUs). City climate goals aim for residents to have the choice to forgo a car and rely on non-motorized modes of transportation or public transit (especially in compact neighborhoods where it is most feasible), but the current combination of on-site parking requirements, street design standards, and the Winter Parking Ordinance results in significant areas and expense dedicated to vehicular parking. How these parking regulations fit together, along with street maintenance, will need to be holistically reconsidered in order to allow for development that is consistent with Flagstaff's housing and climate goals.

6.2.3.2 *Impact on Key Outcomes*

HOUSING		**CLIMATE**	
●	Abundant Housing Supply	●	Community Resilience, Health and Safety
●	Diversity of Housing Types	●	Sustainable Transportation Networks and Neighborhoods
●	Lower Cost Market Rate Housing	●	Electric Mobility
●	Income-Restricted Affordable Housing	●	Energy
●	Mixed Use Development and Neighborhoods	●	Waste and Water
●	Infill Development and Compact Land Use	●	Healthy Forests and Carbon Dioxide Removal
●	Equity and Fair Housing		
LEGEND			
●	Critical Barrier	●	Minor Barrier
●	Major Barrier	●	Not a Barrier/Not Applicable

6.2.3.3 Code Section(s)

- 9-01-001-0003.E.7

6.2.3.4 Analysis of Issues and Impacts

Per Flagstaff Traffic Code Section 9-01-001-0003.E.7, “no person shall park, or permit to be parked, on any street between midnight and 7:00 a.m., from November 1st to April 1st, any vehicle owned or controlled by that person.” This is commonly known as the Winter Parking Ordinance, in place to support winter snow removal. The restriction is enforced by the Police Department with parking tickets even if it is not snowing, and with vehicle towing and citations if it is snowing. There are some exceptions, but otherwise the ordinance is city-wide.

As discussed in Section 4.1, urban local streets are currently designed with space designated for parking on both sides of the street. However, since this parking can’t be used by residents for almost half of each year, this space cannot support residential development yet must be maintained by the City.

Residential development is required to provide parking, and this ordinance makes it so all parking must be provided off-street. This takes up significant amounts of space, decreasing development efficiency and walkability while increasing the very car dependency issue that creates the need for the parking in the first place. The need to provide on-site parking also increases costs and makes housing less affordable.

The combination of on-street parking space in street cross sections with the requirement for on-site parking associated with development results in redundant spaces and higher monetary costs for both the City and private property owners (and renters). More carbon emissions result from more paving materials and maintenance work needed, and more impervious area exacerbates drainage challenges.

The Winter Parking Ordinance may have a more significant impact on medium density residential neighborhoods that include a mix of compact single-family homes and small multifamily developments. In other similar cities, these types of compact residential areas may or may not have driveways and/or garages, or they may have infill density that creates more parking demand than can fit on the typically smaller lots. When on-street parking is allowed, residents may choose to have a car or not, and this decision does not limit where they may live and can help save money on purchasing or renting a home when street parking is an option. As such, the ordinance has an uneven financial impact on lower- and middle-income groups.

In Flagstaff, the City has noted that the need to provide on-site parking may hinder dense infill or redevelopment opportunities in areas with smaller lots, such as older neighborhoods including downtown Flagstaff. There may not be adequate space for on-site parking to support one residential unit, let alone a few units or the addition of an ADU. Housing in these compact neighborhoods may promote other modes of transportation including walking, biking, and transit, but housing units can’t be built if the city’s current minimum parking standards aren’t met. This is a significant missed opportunity for more cost-effective housing production as well as housing that supports City climate goals.

6.2.3.5 Co-Benefits of Addressing the Barrier

The combination of on-site parking requirements, street design that requires on-street parking, and the Winter Parking Ordinance prevents development from being more compact, decreases infill development potential, and limits potential economic and sustainability upsides to car-free living. These factors need to be reconsidered together to facilitate denser development, which will increase transit viability and walkability and decrease infrastructure costs that impact both the City and residents. This will support housing availability, housing affordability, and carbon neutrality goals related to sustainable transportation, which in turn can bring savings on the cost of living in Flagstaff and improve quality of life.

6.2.3.6 Tensions with Other Policy Goals

With climate change, global temperatures are rising, and seasonal weather patterns that have existed in the past may become less predictable. Climate modeling and current trends show a decrease in the amount of snow during winters in Flagstaff. At the same time, though snowstorms may be less frequent, each could have the potential for larger amounts of precipitation due to more energy in the atmosphere associated with climate change. The same one-size-fits-all approach to addressing snow removal through the prohibition of on-street parking overnight is worth reconsidering in light of these changes.

If vehicles are parked on streets while snow needs to be plowed, snow plow operators must work around the vehicles and there is some risk for parked vehicles. Additionally, where plows can't plow up to the curb, not all snow can be cleared and snow berms are left behind in the street, sometimes blocking in parked cars. Under current practice, snow plow operators are sometimes directed to skip streets that have illegally parked vehicles due to concerns about vehicles getting damaged by snow berms. Police have the responsibility to enforce the parking ordinance by ticketing vehicles, including when there is no snow.

Snow removal operations would have to adjust if the Winter Parking Ordinance were to be removed. More care when plowing around vehicles would be needed, and snow would not necessarily be perfectly removed from the street on the first pass. However, other cities with winter conditions such as Chicago, Illinois or Anchorage, Alaska allow on-street parking with the understanding that snow plowing sometimes requires multiple passes to clear snow. Some vehicles may face getting "plowed in," but residents understand that by parking on the street, they may face using a shovel to dig some snow out of the way. During daytime hours when fewer vehicles tend to be on residential streets, or during specific hours posted on temporary signage when residents are asked to park elsewhere (such as the other side of the street), plows can plan to return and clear additional snow. It would be the risk and responsibility of the individual leaving a vehicle in the street to potentially dig out their vehicle if plowed in, and ticketing could be used for enforcement as well (as it is now for the Winter Parking Ordinance).

If on-site parking requirements were to be reduced as a result of other analysis in Section 4 of this report, the market may shift so that residents either pay extra for on-site parking or park elsewhere such as on the street if needed. This could allow housing to become more dense and more affordable. More affordable and dense housing without on-site parking may incentivize more sustainable transportation choices, such as decreasing cars per household or choosing transit and active modes instead.

6.2.4 *Dead-Ends and Street Connectivity*

6.2.4.1 *Summary*

As Flagstaff has continued to grow, there have been many new residential subdivisions on peripheral greenfield sites that typically have estate, rural, or single-family residential zoning. The phrase used in street design standards, “conventional suburban development,” is an accurate descriptor for these subdivisions, as they have limited connections to major roads, limited connections between different neighborhoods, and many dead-end streets ending in cul-de-sacs. Current zoning in these types of subdivisions typically produces low-density single-family homes that are geared towards higher-income groups.

At times, dead-end streets are needed, or transportation connections cannot be made due to constraints such as topography. However, there may be instances of subdivision street networks being designed to intentionally decrease connections and create dead-ends to either establish a more secluded neighborhood feel or to minimize the extent of public roads constructed with development. Dead-ends and disconnected streets decrease transportation access and efficiency for residents, City and other services, and emergency responders. Street networks with unnecessary dead-ends create a disconnected and redundant development pattern that discourages sustainable transportation such as active modes or electric micro-mobility. Code currently does not discourage this development pattern despite conflicts with City policy goals.

6.2.4.2 *Impact on Key Outcomes*

HOUSING		**CLIMATE**	
🔵	Abundant Housing Supply	🟠	Community Resilience, Health and Safety
🟠	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🟠	Lower Cost Market Rate Housing	🟠	Electric Mobility
⚪	Income-Restricted Affordable Housing	🔵	Energy
🔵	Mixed Use Development and Neighborhoods	🔵	Waste and Water
🔴	Infill Development and Compact Land Use	🔵	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

6.2.4.3 Code Section(s)

- 13-10-004-0001
- 13-10-007-0001

6.2.4.4 Analysis of Issues and Impacts

Current engineering standards provide guidance for organizing streets in neighborhoods and specific dimensional requirements for streets based on traffic volume. Section 13-10-007, Horizontal Alignment states:

"Alignment shall be so arranged as to discourage through traffic on local streets. It shall also provide for through traffic around residential districts. Street alignment shall provide adequate access for police and fire protection, snow plows, and for other road maintenance equipment on local streets and good access on arterial and collector streets. The alignment shall provide for the continuation of arterial and collector streets to adjoining properties not yet developed."

Code indicates that through traffic on local streets is to be discouraged, with a preference towards routing local traffic via larger roads around neighborhoods. This portion of the code is not in compliance with the current Regional Plan's emphasis on increasing connectivity, and the result can be seen in current subdivision development patterns that have broader impacts. Many single-family developments have been built or are in planning stages that revolve around a collection of dead-end streets with minimal access to outside larger streets or adjacent neighborhoods, providing a secluded environment that discourages through traffic. However, this pattern conflicts with access for emergency responders and City services like waste pickup, street maintenance, and utilities. Additionally, the resulting development is generally low-density and inefficient, making these single-family neighborhoods less affordable. While there may not be much traffic to conflict with active modes of transportation from a comfortable recreation standpoint, dead-end streets are not conducive to practical and efficient transportation via active modes or transit access, as they create a disjointed street network weaving through private properties.

Code places a limit on the length of dead-end streets in Section 13-10-004-0001.A: "No dead end street of a permanent nature shall be longer than one thousand two hundred (1,200) feet. The street will terminate with a cul-de-sac, as shown in the Standard Details. …" Dead ends may sometimes be necessary due to property boundaries and/or environmental constraints limiting the connection of a roadway. However, in other cases they may be planned simply to create exclusive and quiet roadways. In order for the City to accept the costs associated with maintaining these stretches of road that only serve a select few residents and cannot contribute to overall street network connectivity, there should be some parameters on when a dead-end street is acceptable as a public road.

By taking on the cost to maintain unnecessary cul-de-sacs, which tend to be used in low-density neighborhoods following "conventional suburban development" patterns, the City may be unintentionally subsidizing and encouraging these development patterns. In subdivision reviews, there have been examples of City staff commenting on quantity of cul-de-sacs and developers reducing the number by more than half, suggesting that these are not always necessary based on site constraints and could be limited with code provisions that formalize reducing dead-end streets.

To discourage new dead-end streets and neighborhoods with very limited connectivity, the City could consider the following:

- Adopt subdivision and street design standards that specifically state a requirement that public roads can only be planned with dead-ends when under specific and prescribed site conditions that preclude through streets.

- Require new subdivisions to plan for more connections between adjacent neighborhoods – the street network should not require exiting all the way to the main collector or arterial outside a subdivision just to access the next local street over that happens to be in the neighboring subdivision.

- Consider adding requirements for a multimodal access easement and/or facility to provide connectivity for active modes from dead-end streets to adjacent FUTS or other multi-modal networks (when topography and other potential site constraints allow). These connections can be informed by the ATMP.
- Even within current code constraints, there is a possibility for City Council to set special street requirements for a particular area according to 13-10-012-0003, Special Districts. This could present an opportunity to pilot a pattern of “conventional suburban development” that has more connective streets and/or active transportation routes and is more efficient in terms of cost and climate goals.

6.2.4.5 Co-Benefits of Addressing the Barrier

Limiting dead-end street development and promoting connections between subdivisions would promote more connected neighborhoods that have improved transportation efficiency for all users, including vehicles and active modes. Efficient and comfortable connections can help encourage more people to travel via active modes, including to access transit. This may also go hand in hand with more compact development patterns, allowing for more housing production at lower price points. There could also be cost and resource savings for the City and taxpayers to not have to maintain extensive amounts of dead-end infrastructure.

6.2.4.6 Tensions with Other Policy Goals

Cul-de-sacs are sometimes used to avoid impacts on steep slopes. The City may need to allow greater impacts to slopes in order to avoid extensive use of cul-de-sacs (slopes are discussed further in Section 4.6, Resource Protection Overlay Zone).

There will still be times when dead-end streets are determined to be necessary based on physical conditions of the land. Developers have indicated that the current required radius is highly land consumptive and creates a very large impervious area, which creates cost and drainage concerns. The City could consider re-examining cul-de-sac requirements to eliminate on-street parking and provide only the minimum that is needed for fire and emergency access.

6.2.5 *Driveways Serving Residential Development*

6.2.5.1 *Summary*

Any residential development containing over two residential units is required to meet commercial driveway standards. The triggering of commercial driveway standards requires more space and cost that may discourage “gentle density” projects that either currently could fit into single-family or medium density residential areas or may be allowed in these zones in the future due to their compatibility with single- and two-family homes (such as triplexes and fourplexes or properties with two ADUs). Wider driveways also create larger curb cuts, decreasing safety and comfort for active modes of transportation.

6.2.5.2 *Impact on Key Outcomes*

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🔵	Community Resilience, Health and Safety
🟠	Diversity of Housing Types	🟠	Sustainable Transportation Networks and Neighborhoods
🟠	Lower Cost Market Rate Housing	⚪	Electric Mobility
🔵	Income-Restricted Affordable Housing	⚪	Energy
🟠	Mixed Use Development and Neighborhoods	⚪	Waste and Water
🔴	Infill Development and Compact Land Use	⚪	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

6.2.5.3 *Code Section(s)*

- 13-10-010-0001

6.2.5.4 *Analysis of Issues and Impacts*

According to FCC Section 13-10-010-0001, “residential driveways are defined as those serving single-family or duplex housing. Those serving more than two (2) dwelling units are classified as commercial driveways…”

Driveway width requirements are not listed in the code, with the code referring to Maricopa Association of Governments (MAG) details that are only partially included in the standard details

in Title 13. Width requirements have been sourced from MAG details online[15] and are shown in the table below. Driveway separation and directional requirements are not clearly stated in code, but have been collected from given information in the table below. (In the future, this information should be consolidated in the code for clarity and ease of reference for developers.)

As shown in the table below, any residential development with at least three units must have access via a driveway meeting commercial standards. Redevelopment requires upgrades to meet current standards, decreasing the likelihood of bringing outdated units up to date as well as infill development that could add additional density, including cases such as adding ADUs. The commercial driveway standards discourage small multifamily developments that do not need larger driveways and cannot always absorb the cost and space required to construct the larger driveways. Larger driveways built to commercial standards may also appear aesthetically inconsistent with their surrounding neighborhood that could include a mix of single family and small multifamily developments.

Table 22. Summary of Driveway Standards

<table>
<tr><th rowspan="2">Driveway Type*</th><th rowspan="2">Road Access</th><th rowspan="2">Residential Units</th><th colspan="2">Driveway Width</th><th rowspan="2">Driveway Separation</th></tr>
<tr><th>Minimum</th><th>Maximum</th></tr>
<tr><td rowspan="2">Residential</td><td>Local</td><td rowspan="2">1 or 2</td><td>12’</td><td>30’</td><td>10’
(back-out allowed)</td></tr>
<tr><td>Minor Collector</td><td>12’
16’ desirable</td><td>30’</td><td>125’
(head-out only)</td></tr>
<tr><td rowspan="2">Commercial</td><td>Local</td><td rowspan="2">3+</td><td rowspan="2">16’
24’ for two-way driveway</td><td rowspan="2">40’</td><td>10’
(head-out only)</td></tr>
<tr><td>Minor Collector</td><td>125’
(head-out only)</td></tr>
<tr><td colspan="6">*Note: Flagstaff code distinguishes driveway requirements by development type as shown in this table, and developments with 3+ units must follow “commercial” standards. MAG details 250-1 and 250-2 reference commercial or residential, but MAG detail 251 references residential and commercial *zoning*. This discrepancy should be eliminated for clarity, as development subject to each of the two driveway types is possible in either residential or commercial zoning in Flagstaff.</td></tr>
</table>

Commercial driveways require a minimum width of 16 feet, regardless of the street they access. The local street from which a triplex takes access could have a design speed as low as 20 miles per hour and still require the wider driveway, taking up more space on site and requiring more

[15] https://azmag.gov/Portals/0/Documents/MagContent/2024%20-MAG-DETAILS-for-Public-Works-Construction.pdf, Details 250-1 (rev. 2014), 250-2 (rev. 2013), and 251 (rev. 2021).

resources and cost to build. Commercial driveways are also required to be head-out only, regardless of what street they access. This forces more space to be used on site to allow for a turnaround and/or a 24-foot minimum two-way driveway, or other design solutions like two 16-foot driveways that take up even more space and must follow separation requirements.

These requirements are a barrier that discourages “gentle density” projects that either currently could fit into single-family or medium density residential areas or may be allowed in these zones in the future due to their compatibility with single- and two-family homes (such as triplexes, fourplexes, and potentially more). This encourages single-family neighborhoods to remain exclusively single-family development, which tends to be higher cost and less efficient from an infrastructure cost and sustainability perspective. Especially while the City is also considering potential changes to on-site parking requirements, the City should consider whether narrower driveways can meet site needs, particularly for small multifamily developments and in areas where transit and active mode networks are likely to help lower the amount of vehicles needing to access site driveways.

Wider driveways require wider curb-cuts, which also increase interruptions and vulnerable points along routes dedicated to active modes, including sidewalks, pathways, and provisions for bicycles. Particularly in areas that are likely to have higher numbers of people traveling by transit and active modes, the City should consider how to minimize driveway / curb cut conflicts for active modes and prioritize their safety.

6.2.5.5 Co-Benefits of Addressing the Barrier

Larger driveway requirements can increase cost and reduce the amount of land available for housing, decreasing the feasibility of small multifamily developments. These types of developments are an important opportunity to introduce more density to existing residential areas to take advantage of infill development infrastructure efficiencies and creating development that works for walkable and transit-friendly development.

Larger curb cuts are also a detriment to active transportation modes as they are longer vulnerable spaces where vehicles cross paths dedicated to active modes. Narrower driveways may also force drivers to slow down more when entering and exiting.

Larger driveways also add impervious surface, increasing stormwater runoff, while also consuming higher amounts of high-emissions resources.

6.2.5.6 Tensions with Other Policy Goals

In some locations, it may make sense for developments to share driveways or have no driveways at all. Part of decreasing driveways and driveway widths is tied to on-site parking, which may be considered for reduction as discussed in Section 4 of this report. This discussion must also consider potential changes to policies around on-street parking, as discussed in Sections 6.2.2 and 6.2.3 of this report. Generally, as there is a goal of promoting transit and active modes to support carbon neutrality and other climate outcomes, some decisions and compromises may need to be made to decrease space dedicated to vehicles in new developments (and how this relates to surrounding transportation infrastructure design).

6.2.6 *Landscaping in Rights-of-Way*

6.2.6.1 *Summary*

On both sides of all urban street sections, at least five feet of parkway (landscaped strip along a right-of-way) is required. This adds at least ten feet of landscaped area to every cross-section. Details of street cross-section widths and priorities, and their impacts to housing and climate goals, are discussed earlier in this report in Section 6.2.1 and 6.2.2. This section reviews the potential housing and climate impacts related to landscaping requirements within parkways (not the inclusion of parkways).

Landscaping along streets can enhance neighborhood aesthetics and safety for sidewalk or trail users along streets. Landscaped areas provide space for snow storage, natural drainage, wildlife habitat, and space for other infrastructure and amenities like signs, fire hydrants, mail boxes, benches, and bike racks. However, the landscaping can add significant cost both for installation and long-term maintenance, and maintenance responsibilities are not always clear. Irrigation needs can also significantly increase water usage despite the City's water conservation goals. Landscaping standards may not adequately discourage using plants that require irrigation to survive, which takes from Flagstaff's already limited water supply, particularly where purple pipe (reclaimed) water access is not available.

6.2.6.2 *Impact on Key Outcomes*

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🔵	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🔵	Sustainable Transportation Networks and Neighborhoods
🟠	Lower Cost Market Rate Housing	⚪	Electric Mobility
🟠	Income-Restricted Affordable Housing	⚪	Energy
🟠	Mixed Use Development and Neighborhoods	🔴	Waste and Water
🔴	Infill Development and Compact Land Use	⚪	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

6.2.6.3 *Code Section(s)*

- 13-18-002-0003

- 13-18-003-0001
- 13-18-003-0002

  13-19-001-0001

6.2.6.4 Analysis of Issues and Impacts

Landscaped parkways have positive impacts, including aesthetics, natural drainage, space for snow storage, and safety and comfort for active modes of transportation using sidewalks or trails along streets. These support work towards City climate goals.

However, there are some trade-offs associated with landscaped parkways as currently prescribed. Five feet of parkway on either side of every road, including low-speed local streets, may be more than is needed to provide space for snow storage and protection for active modes. As discussed in Section 6.2.2, the City may wish to consider different ways to make local streets narrower to allow neighborhoods to be more compact and reduce development costs that translate into higher housing costs; making the elements of local street cross-sections narrower (including potentially parkways) could support several housing and climate outcomes examined in this study.

Landscaping adds to up-front and maintenance costs, which can add to housing costs. The City has also indicated that it is not always clear who is responsible for landscaping maintenance within the ROW. According to the engineering standards, ROW landscaping maintenance is the responsibility of the City's Parks, Recreation, Open Space, and Events Division (PROSE), but PROSE only has funding for maintaining some of this landscaping based on designated funding from Bed, Board, and Beverage (BBB) tax revenue. Some subdivisions may have license agreements with the City for maintaining ROW landscaping. ROW landscaping not accommodated through one of these means does not have any specific party identified for maintenance responsibilities.

Section 13-18-002-0003.2.A sets standards for spacing trees within parkways along streets, and other requirements for trees, shrubs, and living groundcover are detailed in Tables 13-18-002-01, 13-18-002-02, and 13-18-002-03. These requirements are extensive and potentially confusing based on different transects (which apply for the landscaping standards even if not within TND), "thoroughfare types" and the sheer amount of information provided. Requirements vary and may include different degrees of flexibility depending on each transect. While the planting of street trees has pedestrian safety and comfort advantages, requiring adequate space and resources for street trees spreads out development patterns and may have less sustainability benefits than allowing more compact development in order to preserve more forested areas on the outskirts of the city.

Besides space and cost considerations, landscaping that requires irrigation can be a significant environmental cost given that the City has limited water supply. Section 13-18-002-003.3.F acknowledges this:

"Landscape designs should balance the value of landscaping and the value of responsible water usage. Selection, density, and placement of plants relative to available water supplies need to be considered in the design concept. The selection of native and drought tolerant species is encouraged. Use of reclaimed water for irrigation substantially addresses this balance."

However, the section also acknowledges that plantings in more urban areas tend to be more formal in design and will need more water. Especially given increasing water supply challenges in the region and climate change impacts, the City should consider requiring that landscaping exclusively uses plants that are native and/or drought tolerant. Some irrigation during plant establishment period makes sense, but long-term cost and water usage associated with permanent irrigation systems and regular irrigation schedules for plants that can't survive otherwise should be fully discontinued unless reclaimed water can be used, especially for those plantings in streets that the City will be eventually responsible for maintaining.

Section 13-18-003-0002.A, Irrigation states that except for native planting areas or areas along streams, "all landscaped areas within rights-of-way shall be provided with permanent automatic irrigation systems designed to minimize water usage but provide adequate watering for all plant materials." Permanent irrigation systems significantly add to development cost, impacting housing cost, as well as the environmental cost of higher water usage. As discussed above, code could be rewritten to explicitly prohibit use of non-native plants that are not able to survive Flagstaff's local climate and water challenges that may be associated with climate change in the future. Code could also prohibit permanent irrigation systems unless they are able to connect to a source of reclaimed water. Alternative design features that are attractive, maintain impervious area for snow storage and drainage, but do not require watering (such as art features) could also be considered as alternatives to decrease maintenance needs.

Current uncertainty around parkway landscaping maintenance also needs to be resolved, for reasons beyond aesthetics or cost. Drying plants that do not have adequate water may become wildfire fuel in fire-prone Flagstaff. While at first glance landscaping within the ROW is an environmental improvement, it can also bring sustainability issues and risks.

6.2.6.5 Co-Benefits of Addressing the Barrier

There are many benefits to landscaped parkways along ROWs. However, the City could consider altering requirements to allow smaller areas, and requiring that landscaping only includes native plants that are prepared for Flagstaff's future climate. Native plants are the most resilient, support native ecosystems, and encourage a place-specific appreciation of the natural environment.

If higher-density development and reduced setbacks adjacent to ROWs become easier to achieve through potential changes to zoning code, maintaining landscaped parkways can help balance the higher density with natural buffers between buildings and streets.

6.2.6.6 Tensions with Other Policy Goals

Per Chapter 13-19, the City prefers that irrigation systems use reclaimed water; there is a treatment plant and pipe system for this resource.[16] When plants do require irrigation, this is a way to counteract potential watering needs that is consistent with the City's climate goals. Rather than requiring permanent irrigation systems, the City could require that any irrigation systems use reclaimed water. However, building connections to the system could be a major cost, so requiring connection should be avoided for projects not near the current system extents unless the City is able to assist with extending the system.

[16] https://www.flagstaff.az.gov/128/Reclaimed-Water-System

6.2.7 Additional Minor Barriers and Issues

There are additional regulations in Title 13 which are important to address but are not considered major or critical barriers to meeting the City's housing and climate goals. Table 23 provides a list of these issues and a brief description of how the regulations presents a minor barrier to housing and/or climate goals.

Table 23. Additional Minor Transportation and Access Barriers and Issues

CODE SECTION	DESCRIPTION OF BARRIER / ISSUE
Traditional Neighborhood Thoroughfares (13-10-012)	The "traditional neighborhood thoroughfare" alternatives include options that could support higher density, more affordable, and less carbon-intensive development patterns, according to design that is sensitive to developments' context in areas that are rural, urban, or anywhere in between. Safe transportation via active modes is a priority. However, these street standards are even more complex than "conventional" street design standards and almost never used. The system for determining "thoroughfare" requirements is based in urban theory and reads more like theory than a section of engineering code. In one instance, streets are described as "CITY BUILDER OR DESTROYER" (13-10-012-0001.3). This language style should be reserved for planning documents, not codified engineering standards, in order to facilitate interpretation and use of the standards. Section 13-10-012-0001.2.A describes different Speed/Movement Types that thoroughfares could have, and notes that "the design criteria for yield, slow, and free streets shall be commensurate with local streets and the speed and rural with minor collector streets." Per 13-10-012-0006, developers would be required to prepare a "Thoroughfare Selection Report," which may be included in the TIA. City staff has indicated that this is very subjective and has almost never been used. It may be more effective to remove the complex thoroughfare street design options and instead modify existing local and minor collector requirements to better accommodate urban context and City goals such as promoting sustainable transportation.
Rear Alley Setbacks (13-10-005-0001 and Detail 10-09-050)	Alleys are sometimes associated with "traditional neighborhood development" with building-forward, pedestrian-oriented primary frontages and vehicular loading in the rear of residential properties. This development pattern tends to align with City housing and climate goals. However, Section 13-10-005-0001 requires garages to be set back a minimum of 8 feet adjacent to rear alleys, presenting a barrier to more compact and efficient residential neighborhoods. Rear-loaded homes with alleys present an opportunity to design higher density neighborhoods and visually deemphasize suburban expanses of driveways and garages between homes and public streets. However, requiring the 8-foot minimum garage setback in the rear just places driveways in the rear, defeating the purpose of the alley providing more compact access. In many cases, an 8-foot setback is inadequate to

CODE SECTION	DESCRIPTION OF BARRIER / ISSUE
	accommodate parking for increasingly larger vehicles like SUVs, so the space may not even be useful as vehicular parking. Furthermore, local residential streets are currently designed with on-street parking. All of these elements combine to result in neighborhoods that dedicate a very significant portion of space to cars. There are already some exceptions to alley setbacks outlined in zoning code, for accessory structures including garages and ADUs, depending on zoning district. Alley access can support detached ADUs, since they can be built at a zero-foot setback from an alley (and allow ADU occupants to access from the back). In light of potential upcoming changes to zoning and engineering code, it may make most sense for the City to use the opportunity to remove references to the alley setback in engineering code and details, instead allowing zoning code to define any setback requirements, including along rear alleys. Removing alley setback requirements would decrease the amount of space needed for development and allow more units that are more affordable and sustainable. This change, in combination with working out narrower streets for the front of this compact development pattern, would likely encourage more townhome development, which developer stakeholders indicated has essentially ended due to these wide street and alley requirements.
Alley Improvements (13-10-005-0001.D)	Infill development may be discouraged by standards that require improvements to existing alleys. According to Section 13-10-005-0001.D, existing alleys used for ingress-egress to required parking must be improved behind the parcel being redeveloped and all the way to at least one end of the alley. This could be a significant cost for a single property owner that may wish to redevelop their site. There may be pre-existing alley encroachments to navigate, making the project more complex and increasing cost. This code provision places a major burden on the first parcel on rear-loaded block that might decide to redevelop.
Driveways on Vertical Curbs (Table 13-10-011-01 and MAG details)	Regardless of street functional classification, Table 13-10-011-01 indicates that vertical curb is required. A note after the table indicates that “rolled curb is permitted on streets in townhome and planned options” in front of lots no wider than 40 feet. For a combination of reasons, City staff and development stakeholders have indicated that townhomes are almost never constructed in Flagstaff due to code issues. Therefore, vertical curbs are essentially required everywhere. Based on MAG details, curb cuts extend significantly beyond required driveway widths due to the wings that are required to transition grade on vertical curbs. Stakeholders have indicated that this takes up significantly more space and makes driveways overbuilt, increasing cost. Expanded use of rolled curbs in residential neighborhoods may provide an opportunity for housing development cost savings and smaller curb cuts that slow vehicles as they cross space dedicated to active modes of transportation.

6.3 Transportation Impact Analysis

6.3.1 Transit and Active Modes Considerations

6.3.1.1 Summary

While Traffic Impact Analyses (TIAs) have traditionally been utilized as a means of assessing adequacy of vehicular transportation systems, they also present an opportunity for the City to assess other modes of transportation, including transit, walking/rolling, and bicycling. Current language within the TIA manual and City code allow for sustainable modes to be addressed, but requirements are not clearly laid out. Since operational thresholds for sustainable modes are unclear developers struggle with the additional cost and schedule risk that could come with inconsistent analysis and mitigation requirements. Additionally, this is a missed opportunity to improve the transit and active mode networks through transportation demand management (TDM) measures.

6.3.1.2 Impact on Key Outcomes

HOUSING		**CLIMATE**	
🟠	Abundant Housing Supply	🟠	Community Resilience, Health and Safety
🟠	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🟠	Lower Cost Market Rate Housing	🟠	Electric Mobility
🟠	Income-Restricted Affordable Housing	⚪	Energy
🔵	Mixed Use Development and Neighborhoods	⚪	Waste and Water
🟠	Infill Development and Compact Land Use	⚪	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

6.3.1.3 Code Section(s)

- TIA Manual Sections 3 and 4

6.3.1.4 Analysis of Issues and Impacts

The TIA manual includes a list of issues that must be addressed including operational performance of the existing system, on-site and the adjacent circulation systems, trip generation, trip distribution, and expected impact of the development on the existing system. However, transit (route accommodation, site circulation, and stops) and pedestrian circulation and/or trail connectivity are in a list of issues required to be analyzed “when applicable.” The manual does not discuss in which situations these types of analysis are applicable, to what extent they must be considered, or when mitigation must be implemented.

Since the TIA manual is unclear regarding the circumstances under which transit and active modes should be studied in TIAs, the opportunity exists for inconsistent requirements for non-vehicular impact assessments, if one occurs at all, and any resultant mitigation. Updating language within the TIA Manual and Municipal Code to more directly address the situations in which such study is required could create more predictability for project developers and greater direction for City staff to provide affirmative findings regarding non-vehicular transportation improvements with site development.

Furthermore, there could be opportunities for the City to expand reductions for vehicle trips and mitigation based on bicycle, pedestrian, and transit provisions. By introducing a trip reduction plan (TRP) element to the TIA, similar to a program implemented by the City of Tempe, developers would have the opportunity to reduce vehicle trips generated by a development site. The City of Tempe has three levels of TIA based on peak hour vehicle trips and requires a TRP for TIA levels 2 and 3 with associated minimum reduction targets. The City also requires annual reporting on the strategies identified within a level 2 TRP to monitor travel patterns to the site and show levels of reduction. Allowable mitigation related to transit and active modes include measures such as vehicle parking reduction, facilitating carpooling, facilitating rideshare / bikeshare, providing transit passes, and providing multimodal infrastructure beyond existing code requirements. With this approach a development could potentially mitigate traffic impacts through investment in less expensive active transportation infrastructure, facilitate access to the transit system, and/or implement parking reduction strategies to promote fewer site trips.

6.3.1.5 Co-Benefits of Addressing the Barrier

Addressing vague language regarding alternative modes of transportation in the TIA process could elevate active and transit modalities to the same level of consideration as roads and vehicular transportation, consistent with City climate policy goals. Taking this a step further to consider trip reduction through TDM strategies would also elevate the priority of alternative modes of transportation. Both strategies would support climate goals by reducing vehicle miles traveled (VMT), directly impacting vehicle emissions and long-term traffic congestion. Promoting alternative transportation modes through this combined approach could also facilitate more affordable modes of transportation to help decrease cost of living and reduce mitigation costs for developers.

6.3.1.6 Tensions with Other Policy Goals

While expansion of analysis and potential mitigation towards alternative modes of transportation would improve access to sustainable modes of transportation for residential developments, they still could represent additional near-term costs for developments. However, it is not anticipated that these costs would necessarily be greater than mitigation applied to more conventional vehicular transportation mitigation projects.

6.3.2 TIA Mitigation

6.3.2.1 Summary

Development stakeholders reported that it is difficult to predict what mitigation the City will require as part of the TIA process, and also expressed concern that the mitigation may not be proportional to an individual development's impact, increasing project cost and challenging the financial viability of projects. As a result, developers suggested that they may avoid higher density development or reduce the numbers of units to avoid off-site mitigation. A more clear and consistent approach such as impact fees could reduce the sense of risk to schedule and cost associated with off-site mitigation, encouraging housing development investment through greater predictability. To further combat the high cost associated with roadway mitigation measures, development of a TRP for each site within the TIA would allow for mitigation measures to be expanded beyond adding capacity for vehicles by considering additional alternative transportation facilities. Mitigation measures could include strategies similar to the City of Tempe, Arizona, including the following:

- Provide carpool or vanpool matching services.
- Incentivize or subsidize rideshare, carshare, or bikeshare membership.
- Provide free or discounted transit passes for development users.
- Develop a commute management program.
- Provide multimodal infrastructure beyond existing code requirements (e.g. transit shelters, bicycle/pedestrian paths, wayfinding signs, bicycle lockers/enclosures, etc.).
- Provide commuter facilities such as showers and lockers in the building design.
- Provide real time transportation information displays.
- Support telecommuting or other work shift changes to alleviate impacts to the transportation system during the peak hour.

6.3.2.2 Impact on Key Outcomes

HOUSING		CLIMATE	
🟠	Abundant Housing Supply	🟠	Community Resilience, Health and Safety
🔵	Diversity of Housing Types	🔴	Sustainable Transportation Networks and Neighborhoods
🟠	Lower Cost Market Rate Housing	🟠	Electric Mobility
🟠	Income-Restricted Affordable Housing	⚪	Energy
🔵	Mixed Use Development and Neighborhoods	⚪	Waste and Water
🔵	Infill Development and Compact Land Use	⚪	Healthy Forests and Carbon Dioxide Removal
🔵	Equity and Fair Housing		
LEGEND			
🔴	Critical Barrier	🔵	Minor Barrier
🟠	Major Barrier	⚪	Not a Barrier/Not Applicable

6.3.2.3 Code Section(s)

- TIA Manual – Section 7

6.3.2.4 Analysis of Issues and Impacts

Code indicates that as part of a TIA, the report “shall identify the steps to be taken to mitigate any adverse effects of the traffic generated by the development on the street network within the study area,” with a list of possible offsite improvements that could be required. However, it is not clearly laid out what might be required.

Development stakeholders have reported that it is difficult to predict what mitigation the City will require, and that the program ultimately leans on larger projects that trigger TIAs to address off-site impacts, letting the smaller projects avoid such analysis and mitigation. Off-site mitigation improvements can significantly increase project cost or make a development unfeasible. As a result, developers may avoid higher density development and/or reduce the numbers of units to avoid TIA and/or mitigation trip thresholds. A more clear and consistent approach such as impact fees could reduce sense of risk for schedule and cost to developers.

Section 7, subsection E of the City TIA Manual asserts “if adequate transportation improvements cannot be reasonably recommended, consideration should be given to reducing trip generation,” However, this section does not specify acceptable TDM measures or an associated level of reduction. Further expansion of this section to include acceptable alternative mode strategies such as micro-mobility hubs, employer scheduling policies, and parking

reduction strategies could aid in the preparation of a development TIA, subsequent mitigation recommendations, and improve consideration of alternative modes of transportation.

6.3.2.5 Co-Benefits of Addressing the Barrier

More predictability in TIA mitigation and incorporation of TDM strategies can help bring residential projects to fruition and help developers factor the cost and schedule into complex projects. This can help support more affordable housing development at higher densities, without significant concern that the increased density will tip the scales into a significant off-site mitigation cost. Expansion of alternative transportation modes would also align with City climate goals by creating less vehicle dependence in the City. Use of transit or active transportation modes would decrease the growth of VMT relative to the growth of the city, thereby reducing vehicle emissions.

6.3.2.6 Tensions with Other Policy Goals

While some developers may prefer impact fees, some smaller scale developers may prefer the current system in which their projects weren't subject to TIA requirements. This policy change could add costs to smaller infill developments but offer a more predictable process for larger residential developments in the City. While consideration of TDM measures included within a TIA to mitigate development impacts on the transportation system would positively impact climate and affordable housing goals, more nuanced review of a TIA submitted to the City would be necessary, potentially complicating the compliance assessments at the City level.

6.4 Water, Sewer, and Stormwater

6.4.1 Water and Sewer

6.4.1.1 Summary

The project team has evaluated the various codes and procedures that address utility requirements for new developments in the City, including FCC Titles 8 and 13. Based on the comments received from the development stakeholders and from the team's review of the standards, the most substantial barriers to the City's housing and climate outcomes within these sections are generally the provisions associated with water and sewer infrastructure: the process involved in planning for and assessing project impacts, assigning associated mitigation, and the water and sewer connection fees associated with new development. Further discussion on these issues is provided below.

6.4.1.2 Analysis of Issues and Impacts

Title 8 of FCC addresses the requirements, standards, and responsibilities associated with the dedication, design, and maintenance of sidewalks, public ways, and public properties. Certain requirements found within Title 8 could certainly financially impact residential property owners, but do not conflict with sustainability goals and support important public safety priorities. For example, Section 8-09-001-0004 includes requirements around undergrounding utilities such as electric lines. This cost may have an impact on the development of new residential construction, but these requirements are commonplace in new developments and subdivisions and are rooted in the need to secure these new lines in a manner that is safe from fire and other accidents. Similarly, many Title 13 requirements related to water infrastructure are critical from a fire safety perspective. The table below provides a summary of water and sewer design and process requirements that may present barriers and/or trade-offs to consider in the context of housing and climate goals.

Most of the barriers and opportunities identified are likely to have an impact on housing quantity and cost, meanwhile having limited impact to climate outcomes examined in this study. Therefore, they have been summarized in the table below, according to a format that is similar to the tables in Section 4.11 and 6.2.7 of this report.

Table 24. Water and Sewer Barriers and Opportunities

CODE SECTION	DESCRIPTION OF BARRIER / OPPORTUNITY
Water and Sewer Impact Analyses (13-05-002-0001 and 13-04-002-0002)	WSIA challenges relate primarily to housing production and cost and are expected to have a neutral effect on climate outcomes. In the development stakeholder interview process, the project team heard multiple concerns about the WSIA requirements that included: • The process is costly and perhaps could be more cost effectively addressed if the project team had their consultant prepare the analysis rather than the City, more similar to the TIA process. • The threshold for a WSIA is a project with an equivalent residential unit water generation of 10 single family homes. To require an individual impact analysis at this scale is uncommon compared to many other jurisdictions where the water utility providers maintain

CODE SECTION	DESCRIPTION OF BARRIER / OPPORTUNITY
	more dynamic water system models and have a more continual record of system capacities. Therefore, the requirement for WSIAs at such a threshold represents a unique development cost in the City. • With certain applications, specifically a zone change, the WSIA is required very early when the development program isn't completely known. The WSIA and development agreement must be developed with the zone change, resulting in a significant design investment that is based on speculative project details that may still change significantly, resulting in more cost to rework. The City could consider changing the requirements for WSIAs in certain instances, such as zone changes, and potentially increasing the threshold for project scale requiring a WSIA. These changes would not be anticipated to have negative impacts on other policy goals. In certain instances where the City sees significant opportunities for housing production, the City could conduct area-specific WSIA studies that would create a known capacity for water and sewer units. This would eliminate the need for project-by-project WSIAs and create more certainty regarding the timing and cost of development.
Sewer Flow and Water Demand Assumptions (13-09-002-01 and 13-09-003-02)	The FCC includes tables that address the average sewer daily flow and average water demand that should be assumed in new development impact studies. These tables are located at 13-09-002-01 and 13-09-003-02, respectively. DOWL reviewed the source of these flow rates and demand assumptions, which were derived from a 1980 study. Based on awareness of the projected water and sewer flow rates for other communities, as well as population trends towards smaller households, DOWL would recommend that the City review and consider the appropriateness of these metrics for future use to ensure that the rates are still representative of the current flows in the City. In the event that more current data could support decreasing water demand and sewer flow rate assumptions, this could result in decreased infrastructure needs and therefore costs to new developments, which could have a positive impact towards housing goals.
Pump Stations or Reservoir Requirements (13-09-003-0012)	Section 13-09-003-0012 stipulates that new developments provide pump stations or reservoirs to ensure adequate pressures exist to serve development, which substantially increases development costs and may limit opportunities for new housing in some areas of Flagstaff. The requirement to provide pump stations and/or reservoirs with new development is a practical reality for certain projects that simply cannot demonstrate sufficient pressures in the immediate network. This issue may speak to a policy desire to consider the zoning and density allowances in locations that could need pump stations or reservoirs, to ensure that those sites either (A) have sufficient permitted densities to warrant the utility infrastructure investment and/or (B) are zoned to a scale

CODE SECTION	DESCRIPTION OF BARRIER / OPPORTUNITY
	that would minimize or avoid the need for the pump station or reservoir investment. • Current allowable densities in the R-1 zone are five to six units per acre. This relatively low density may not warrant the level of infrastructure investment of a pump station unless serving a very large number of single-family homes. • On the other hand, a larger, higher-density development may need a pump station. If a site is identified by the City as an opportunity to achieve higher-density and affordable housing outcomes, the City could consider adjusting zoning and contributing to infrastructure such as pump stations to facilitate and subsidize the desired development outcome. • The Regional Plan's Future Growth Illustration land use designations suggest where the City may grow and more development may occur in the future. Based on this map, the City could study areas that are likely to require greater infrastructure needs and consider whether there are any improvements that are appropriate for the City to put in the Capital Improvements Plan (CIP).
Potential Reimbursements for Infrastructure Installation or Improvements (13-09-005-0001)	Section 13-09-005-0001 provides the opportunity for developers or owners who extend water or sewer lines across neighboring undeveloped property to establish a reimbursement agreement consistent with the provisions of Section 7-08-001-0005. This code provision supports housing goals as it helps remove a potential barrier to new development and sets developers up for more equitable cost sharing for new infrastructure installation. The City could consider if there are opportunities to expand this provision more broadly beyond undeveloped property. For example, many older neighborhoods in Flagstaff may have old and now undersized infrastructure that needs to be upgraded in order to allow higher density infill redevelopment. Sometimes the first property owner seeking to redevelop will face the barrier of having to upgrade significant infrastructure. Based on City policy goals to promote infill redevelopment, the City could seek ways to support developers with infrastructure costs and allow cost sharing.
Potential Reductions in Water and Sewer System Connection Fees for Affordable Housing Projects	The City assesses water and sewer system fees with the connection of new residential development. These include a water capacity fee and a sewer capacity fee, along with minor connection fees. The current fee for a single-family residential unit with a ¾" meter is $5,728 for the water capacity fee and $3,723 for the sewer capacity fee. Multi-family projects are assessed a water capacity fee ranging from $9,566 for a 1" meter to $95,484 for a 4" meter. Multi-family projects are assessed $3,723 per unit for a sewer capacity fee. These fees can represent a significant cost to new development. For example, a 200-unit multifamily project would require nearly a $750,000 assessment in sewer capacity fees alone. Some jurisdictions have made

CODE SECTION	DESCRIPTION OF BARRIER / OPPORTUNITY
	policy decisions to eliminate or reduce water and sewer system development charges for low-income housing projects. Adjustments to the City's fee program in a manner that scales the fee to unit size and/or allows a deferral of fee payments to occupancy could be means to relieve the housing cost burden. Alterations to the water and sewer capacity fee programs to provide greater flexibility and scaling of rates could be an opportunity for the City to further reduce barriers to housing. These types of program modifications would need to be carefully reviewed to consider the revenue impact, if any, of such a policy change. However, it could be a way for the City to influence housing development to facilitate projects that align with the City's housing and climate goals.

6.4.2 Stormwater

6.4.2.1 Summary

Following the feedback received from developer stakeholders, DOWL planning and engineering staff conducted a review of the City's Stormwater Design Manual and Low Impact Development (LID) guidance manual to consider the comments received and any other potential barriers or modifications that could be warranted. As previously noted, stakeholder comments ranged from suggestions that the facilities are failing in certain large storm events to suggestions that the facilities are overbuilt based on overly conservative design assumptions. In reviewing the standards, DOWL did not find evidence that the detention requirements were inappropriate; either under-sized or over-sized as was suggested by stakeholders.

Other stakeholders commented that LID standards should be eliminated, noting that there are no critical waterways in the area and most sediment and debris gets settled out in detention basins anyway. It was noted that prevalent soils in the area often don't drain well, so underdrains are often required anyway, resulting in greater project expense.

DOWL engineering staff reviewed the City's Stormwater Design Manual and LID guidance manual for site design and implementation to consider these comments and potential barriers to the City's housing and climate outcomes.

Section 13-05-002-0004 addresses the process for evaluating a project's impacts on stormwater. The City's stormwater management requirements are primarily found in two documents, the 2009 City of Flagstaff Stormwater Management Design Manual (Stormwater Manual) and the 2009 Low Impact Development Guidance Manual for Site Design and Implementation (LID Guidelines). In addition to these manuals, FCC Section 13-05-002-0004 includes provisions that require stormwater impact analyses for general plan amendments and zone change requests.

6.4.2.2 Analysis of Issues and Impacts

Stormwater requirements are typically in place for environmental safety reasons that may be more closely tied to climate outcomes than housing outcomes, but stormwater infrastructure can come at a significant cost to developers which does impact housing production and affordability. It is important to maintain requirements for managing stormwater for climate and safety reasons, but there may be some opportunities to allow more cost-effective designs to reduce barriers to more and more affordable housing development.

Table 25. Stormwater Barriers and Opportunities

CODE SECTION	DESCRIPTION OF BARRIER / OPPORTUNITY
Limits to Open Detention Adjacent to Streets (Stormwater Manual Section 8.4.2)	Section 8.4.2 of the Stormwater Manual discourages open detention basins adjacent to streets due to safety and view concerns. Safety concerns can be addressed via 4-foot chain link fencing when near public spaces, and landscaping requirements can make detention basins visually attractive and address concerns about visual impacts. Locating these facilities adjacent to streets may make most sense given typical site grading.

CODE SECTION	DESCRIPTION OF BARRIER / OPPORTUNITY
	One issue with locating open detention adjacent to streets is that there is a tension with building-forward requirements in the Site Planning Design standards in the Zoning Code. These standards call for buildings close to the street, particularly along the front of developments, which can't happen if a detention basin is between the street and the buildings. A way to address the tension with building-forward design standards could be to consider how parkways and medians could be utilized for storm drainage facilities. LID is not currently permitted within ROWs, but this could be something to consider (since open detention may not be appropriate within the ROW). This is discussed further below in this table.
Storm Drain Conduit Materials (Stormwater Manual Section 7.2.4)	Stormwater Manual Section 7.2.4 provides requirements for storm drain conduit materials. Providing additional allowable pipe types can provide contractors more flexibility regarding construction costs, potentially helping save on the cost of development and therefore helping housing be more affordable.
Low Impact Development Policies (Stormwater Manual Section 9.1.a.3)	The City's LID policies include many provisions that align with City housing and climate goals. There are benefits as well as trade-offs related to LID: • With the City's goal of carbon reduction, LID facilities would have a lower carbon footprint compared to underground detention systems that depend on large volumes of excavation and disposal of spoils, production of materials to construct underground detention (such as concrete, steel, and plastics), and the associated shipping impacts of these materials. • Greater use of mechanical treatment and underground detention systems may be less land consumptive and could result in a more efficient use of a site in certain instances. While such a use may result in a greater carbon footprint, such a use could allow for design efficiencies that could result in greater residential yield, and potentially achieve better housing outcomes. Recognizing that there are trade-offs to LID, it likely makes sense for the City to remain flexible on storm drainage design solutions that developers may propose for different particularities of sites and projects. • Given that LID can be land-consumptive, the City might consider allowing LID within City ROW, such as in landscaped parkways; LID is not currently permitted within City ROW. This would allow more land within a project site to be developed into residential units, supporting housing production and affordability. • Allowing LID in City ROW would also help address a tension between stormwater design and building-forward design policies. If there is not space for stormwater facilities in front of buildings due to site layout with buildings close to streets, it could be appropriate to use space in the ROW for LID drainage facilities. • The Regional Plan and/or neighborhood plans for areas where this may be helpful and appropriate could emphasize exploring this

CODE SECTION	DESCRIPTION OF BARRIER / OPPORTUNITY
	design option and what code or engineering standard adjustments may be needed. The following other opportunities for improvement of LID policies were also identified: • The City's current allowance to eliminate the 2-year detention requirement if 1 inch of runoff can be infiltrated is a good design benefit for development. The City could consider taking this further to clarify that LID facilities can be utilized to meet 10- and 100-year detention requirements. • Slightly larger LID facilities will cost less than LID facilities that were developed with basins/tanks. A Soil Conservation Service (SCS) or Santa Barbara Urban Hydrograph (SBUH) method analysis of the LID systems can account for infiltration, combine multiple onsite facilities, and account for underdrain/overflow outflows. If LID facilities can show compliance with detention standards for the site, there should be no need for additional storm facilities.
Stormwater Credit Program Changes	In addition to the stormwater manual requirements, Flagstaff could utilize its Stormwater Credit program to provide credits for retention above the minimum as an incentive to retain stormwater onsite, as a means to reduce monthly stormwater fees. This could offer significantly reduced monthly stormwater fees for full onsite water quality treatment and retention. Any remaining fees required would be applied towards the upkeep and maintenance of the public stormwater system. Benefits of such a program would more directly be received from a long-term owner-operator, as the ultimate cost benefit would be on monthly stormwater sewer rates and not on initial connection fees. One example of a case when this provision could be very beneficial would be for owners of large multifamily developments; the cost benefit could potentially help keep rents lower and also would be aligned with City climate goals.

APPENDIX **4.1**

PHYSICAL AND FINANCIAL PROTOTYPE MODELING

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT–
DEVELOPMENT CODE DIAGNOSIS REPORT

Development Prototype Models

City of Flagstaff LASS/Code Analysis Project

JUNE 2024

Key Assumptions: Development Costs

Land Costs	$ / sf
Residential - Infill/Finished Lot	$25.00
Residential - Raw Land	$7.00
CB and HC	$40.00
CC and CS	$25.00

Hard Costs - Building Construction	Rate	Basis
Single Family Detached/Duplex (2 Stories)	$275	Per gross SF
Townhouse/Multiplex (2-3 Stories, 3-8 Attached Units)	$300	Per gross SF
Wood Frame Apartments (3 Story, Walk-Up, Type V-B)	$325	Per gross SF
Wood Frame Apartments (4 Story, Elevator, Type V-A)	$350	Per gross SF
Podium/Wrap Building (4-7 Stories)	$400	Per gross SF

Hard Costs - Parking Construction	Rate	Basis
Surface Parking	$5,000	Per space
Structured Garage (1-2 levels above grade)	$20,000	Per space
Underground Structure (1-2 levels below grade)	$35,000	Per space

Soft Costs	Rate	Basis
Professional Services (architecture, engineering, etc.)	7.00%	% of hard costs
Contingency	5.00%	% of hard costs

Site Development and Infrastructure Costs	Rate	Basis
Site/Lot Development (grading, on-site utilities, stormwater)	$22.00	Per sf

Key Assumptions: Market Rents and Prices

Sale Prices - Market Rate	Price/sf	Unit Size	Sale Price
Single Family Detached - Large	$360	2,000	$720,000
Single Family Detached - Small	$380	1,650	$627,000
Townhouse - Large	$315	2,000	$630,000
Townhouse - Small	$300	1,650	$495,000
Condo	$425	1,150	$488,750

Rents - Market Rate	Rent/sf	Unit Size	Monthly Rent	Mix
Single Family Detached	$1.50	2,000	$3,000	-
Townhouse/Duplex	$1.60	1,650	$2,640	-
3 BR Apartment	$2.10	1,150	$2,415	15%
2 BR Apartment	$2.25	850	$1,913	40%
1 BR Apartment	$2.50	650	$1,625	35%
Studio	$3.10	450	$1,395	10%

Rents - Commercial	Rent/sf
Office or Retail	$25.00

Target Returns	
IRR	10%
Project Rate of Return	15%

Key Assumptions: Affordability and Household Costs

Area Median Income	MFI (100%)	80% Low Income	60% LIHTC Max	50% Very Low Income	30% Extremely Low Income
4-Person HH	$105,100	$72,700	$54,540	$54,540	$30,000
Source: https://www.huduser.gov/portal/datasets/il/il2023/2023MedCalc.odn					

Energy Costs	Monthly Costs/sf
Single Family Detached	$0.08
Townhouse	$0.09
Apartments 2-4 Units	$0.10
Apartments 5+ Units	$0.09
Source: https://www.eia.gov/consumption/residential/data/2020/c&e/pdf/ce1.5.pdf	

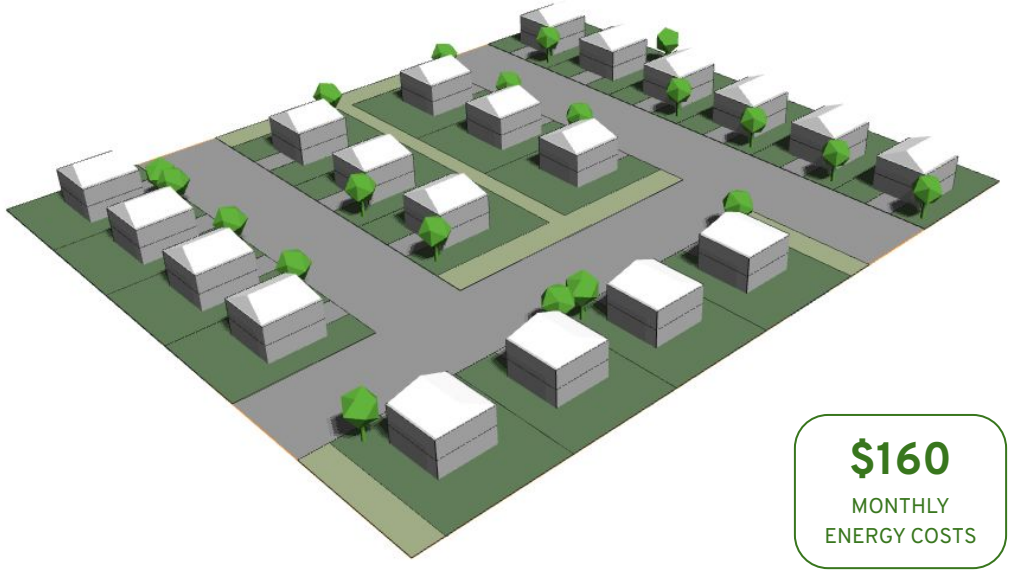
Other Utilities	Monthly Cost
Water/Wastewater	$38.00
Garbage	$25.00
Source: https://img1.wsimg.com/blobby/go/0d4bf07c-125b-49dc-8af5-7824cb627727/downloads/flagstaff_ratesfees_firstdraft_report_20240419.pdf?ver=1718302888085	

Mortgage Terms	
Broker Fees	5%
Loan Term (months)	360
Upfront UFMIP ◊	1.75%
Down Payment ◊	5.00%
Interest Rate	6.0%
Mortgage Insurance	0.85%

R1 Zone

Single-Family Subdivision

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	4.3
LOT AREA sf, average	6,000 min	6,000
DWELLING UNITS	--	20
AVG. UNIT SIZE sf	--	2,000
UNIT DENSITY units/ac	6.0 max	4.7
BEDROOM DENSITY bedrooms/ac	15.0 max	14.0
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	35 max	30
BUILDING FOOTPRINT % of site sf	35% max	21%
FLOOR AREA RATIO gross sf/site sf	--	0.27
COMMON SPACE % of site sf	--	--
PARKING SPACES total	--	40
RES. PARKING RATIO per unit	2.0 min	2.0
COM. PARKING RATIO per 300 sf	--	--



$160
MONTHLY ENERGY COSTS

$6,100
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$253,000
MIN RENTER INCOME
rent < 30%

241%
MIN RENTER AMI
% of area median

$942,800
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

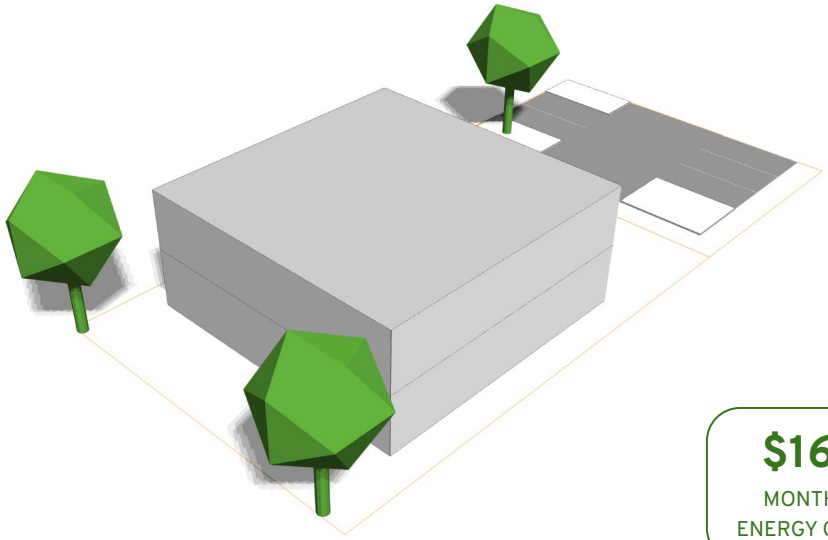
$288,000
MIN OWNER INCOME
mortgage < 30%

275%
MIN OWNER AMI
% of area median

R1N Zone

Infill Site Duplex

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	--
LOT AREA sf, average	6,000 min	9,100
DWELLING UNITS	--	2
AVG. UNIT SIZE sf	--	1,650
UNIT DENSITY units/ac	14.0 max	9.6
BEDROOM DENSITY bedrooms/ac	--	28.7
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	35 max	30
BUILDING FOOTPRINT % of site sf	35% max	23%
FLOOR AREA RATIO gross sf/site sf	--	0.59
COMMON SPACE % of site sf	--	--
PARKING SPACES total	--	4
RES. PARKING RATIO per unit	2.0 min	2.0
COM. PARKING RATIO per 300 sf	--	--



$168
MONTHLY ENERGY COSTS

$5,360
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$826,500
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

$217,000
MIN RENTER INCOME
rent < 30%

206%
MIN RENTER AMI
% of area median

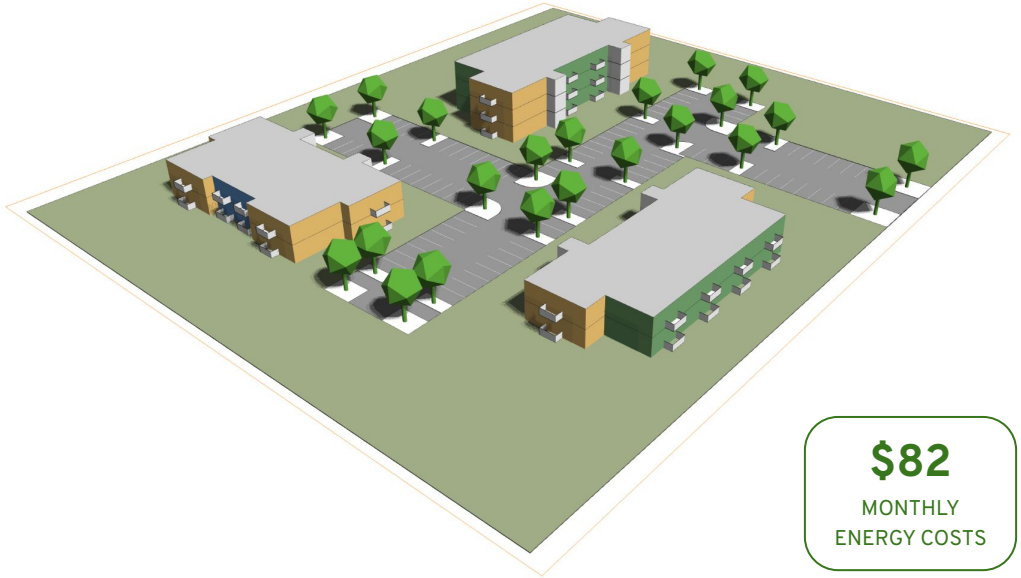
$255,000
MIN OWNER INCOME
mortgage < 30%

242%
MIN OWNER AMI
% of area median

MR Zone

Walkup Apartments/Condos

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	4.3
LOT AREA sf, average	6,000 min	187,000
DWELLING UNITS	--	56
AVG. UNIT SIZE sf	--	895
UNIT DENSITY units/ac	14.0 max	13.0
BEDROOM DENSITY bedrooms/ac	35 max	17.2
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	35 max	35
BUILDING FOOTPRINT % of site sf	35% max	14%
FLOOR AREA RATIO gross sf/site sf	--	0.32
COMMON SPACE % of site sf	15%	68%
PARKING SPACES total	--	98
RES. PARKING RATIO per unit	1.75 min	1.75
COM. PARKING RATIO per 300 sf	--	--



$82
MONTHLY ENERGY COSTS

$3,500
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$143,000
MIN RENTER INCOME
rent < 30%

136%
MIN RENTER AMI
% of area median

$541,000
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

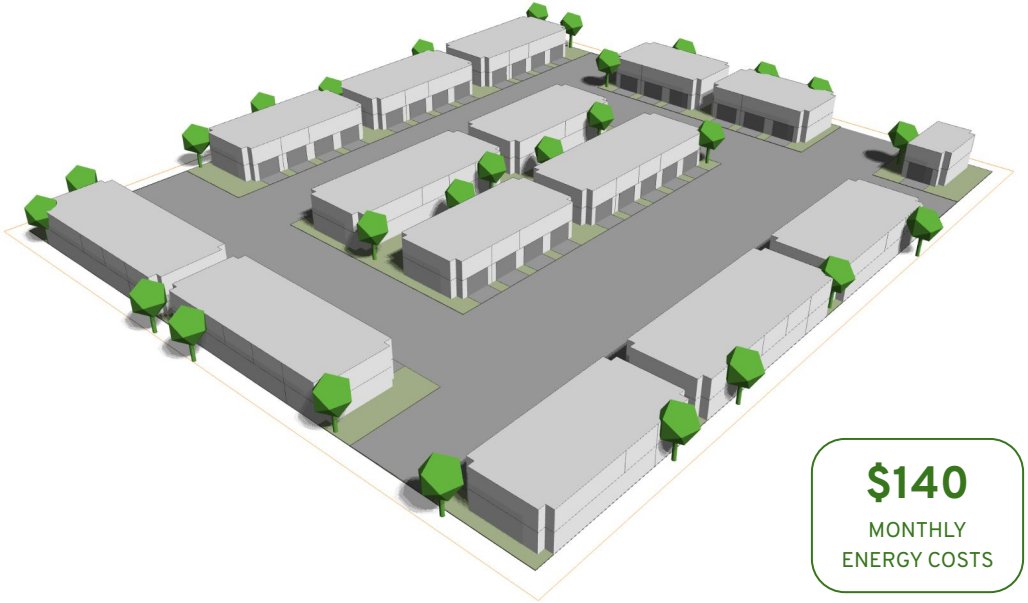
$166,300
MIN OWNER INCOME
mortgage < 30%

158%
MIN OWNER AMI
% of area median

MR Zone

Townhome-Style Condos

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	4.3
LOT AREA sf, average	6,000 min	187,000
DWELLING UNITS	--	60
AVG. UNIT SIZE sf	--	1,600
UNIT DENSITY units/ac	14.0 max	14.0
BEDROOM DENSITY bedrooms/ac	35 max	34.9
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	35 max	30
BUILDING FOOTPRINT % of site sf	35% max	58%
FLOOR AREA RATIO gross sf/site sf	--	0.60
COMMON SPACE % of site sf	15%	23%
PARKING SPACES total	--	120
RES. PARKING RATIO per unit	2.0 min	2.0
COM. PARKING RATIO per 300 sf	--	--



$140
MONTHLY ENERGY COSTS

$4,900
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$198,000
MIN RENTER INCOME
rent < 30%

188%
MIN RENTER AMI
% of area median

$751,300
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

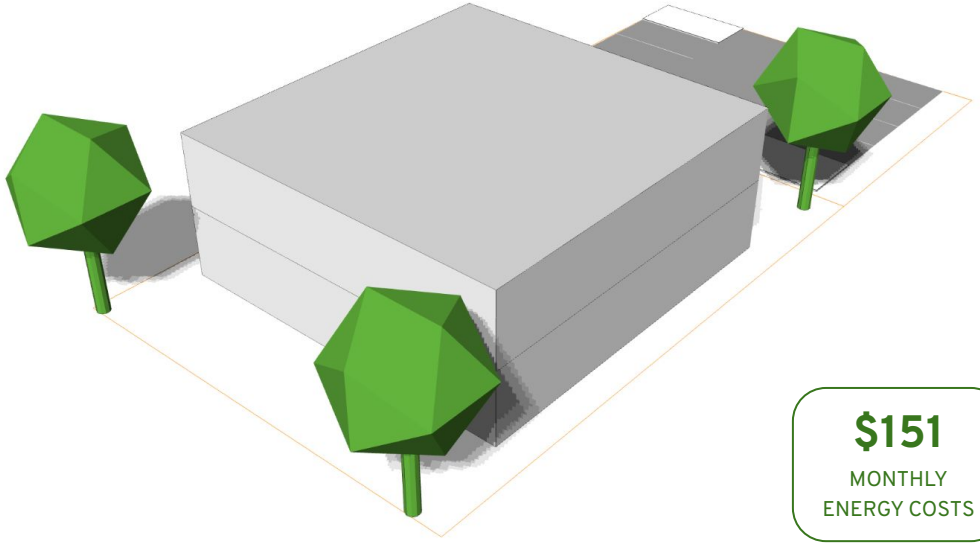
$231,000
MIN OWNER INCOME
mortgage < 30%

220%
MIN OWNER AMI
% of area median

MR Zone

Infill Site Triplex

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	--
LOT AREA sf, average	6,000 min	9,100
DWELLING UNITS	--	3
AVG. UNIT SIZE sf	--	1,650
UNIT DENSITY units/ac	14.0 max	14.4
BEDROOM DENSITY bedrooms/ac	35 max	28.7
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	35 max	30
BUILDING FOOTPRINT % of site sf	35% max	35%
FLOOR AREA RATIO gross sf/site sf	--	0.75
COMMON SPACE % of site sf	15%	31%
PARKING SPACES total	--	6
RES. PARKING RATIO per unit	2.0 min	2.0
COM. PARKING RATIO per 300 sf	--	--



$151
MONTHLY ENERGY COSTS

$5,500
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$855,100
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

$224,200
MIN RENTER INCOME
rent < 30%

213%
MIN RENTER AMI
% of area median

$262,300
MIN OWNER INCOME
mortgage < 30%

250%
MIN OWNER AMI
% of area median

HR Zone

Walkup Apartments/Condos

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	4.3
LOT AREA sf, average	6,000 min	187,000
DWELLING UNITS	--	120
AVG. UNIT SIZE sf	--	887
UNIT DENSITY units/ac	29.0 max	28.0
BEDROOM DENSITY bedrooms/ac	72.5 max	39.1
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	60 max	35
BUILDING FOOTPRINT % of site sf	50% max	23%
FLOOR AREA RATIO gross sf/site sf	--	0.67
COMMON SPACE % of site sf	15%	27%
PARKING SPACES total	--	203
RES. PARKING RATIO per unit	1.69 min	1.69
COM. PARKING RATIO per 300 sf	--	--

$81
MONTHLY ENERGY COSTS

$3,240
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$132,100
MIN RENTER INCOME
rent < 30%

126%
MIN RENTER AMI
% of area median

$498,900
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

$153,800
MIN OWNER INCOME
mortgage < 30%

146%
MIN OWNER AMI
% of area median

HR Zone + Affordable Incentives

Category 1, 12% Affordable Units

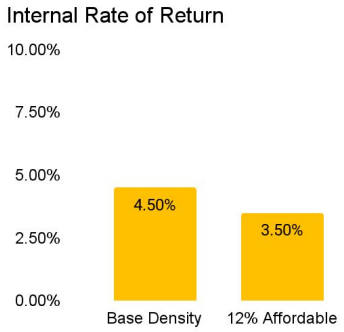
PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	4.3
LOT AREA sf, average	6,000 min	187,000
DWELLING UNITS	--	144
AVG. UNIT SIZE sf	--	888
UNIT DENSITY units/ac	29.0 max	33.5
BEDROOM DENSITY bedrooms/ac	72.5 max	46.6
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	60 max	45
BUILDING FOOTPRINT % of site sf	50% max	23%
FLOOR AREA RATIO gross sf/site sf	--	0.81
COMMON SPACE % of site sf	15%	27%
PARKING SPACES total	--	203
RES. PARKING RATIO per unit	1.41 min	1.41
COM. PARKING RATIO per 300 sf	--	--

$81
MONTHLY ENERGY COSTS

$3,400
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$138,500
MIN RENTER INCOME
rent < 30%

132%
MIN RENTER AMI
% of area median



HR Zone + Affordable Incentives

Category 1, 20% Affordable Units

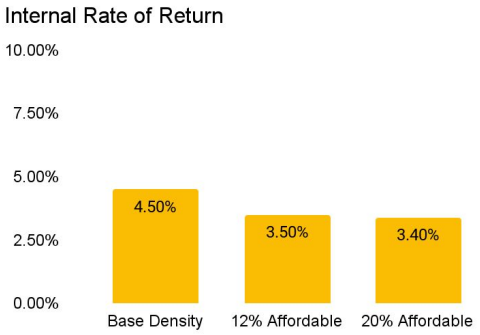
PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	4.3
LOT AREA sf, average	6,000 min	187,000
DWELLING UNITS	--	180
AVG. UNIT SIZE sf	--	740
UNIT DENSITY units/ac	29.0 max	41.9
BEDROOM DENSITY bedrooms/ac	72.5 max	56.8
COMMERCIAL SPACE gross sf	--	--
BUILDING HEIGHT ft	60 max	50
BUILDING FOOTPRINT % of site sf	50% max	23%
FLOOR AREA RATIO gross sf/site sf	--	0.85
COMMON SPACE % of site sf	15%	41%
PARKING SPACES total	--	255
RES. PARKING RATIO per unit	1.42 min	1.42
COM. PARKING RATIO per 300 sf	--	--

$68
MONTHLY ENERGY COSTS

$2,950
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$120,700
MIN RENTER INCOME
rent < 30%

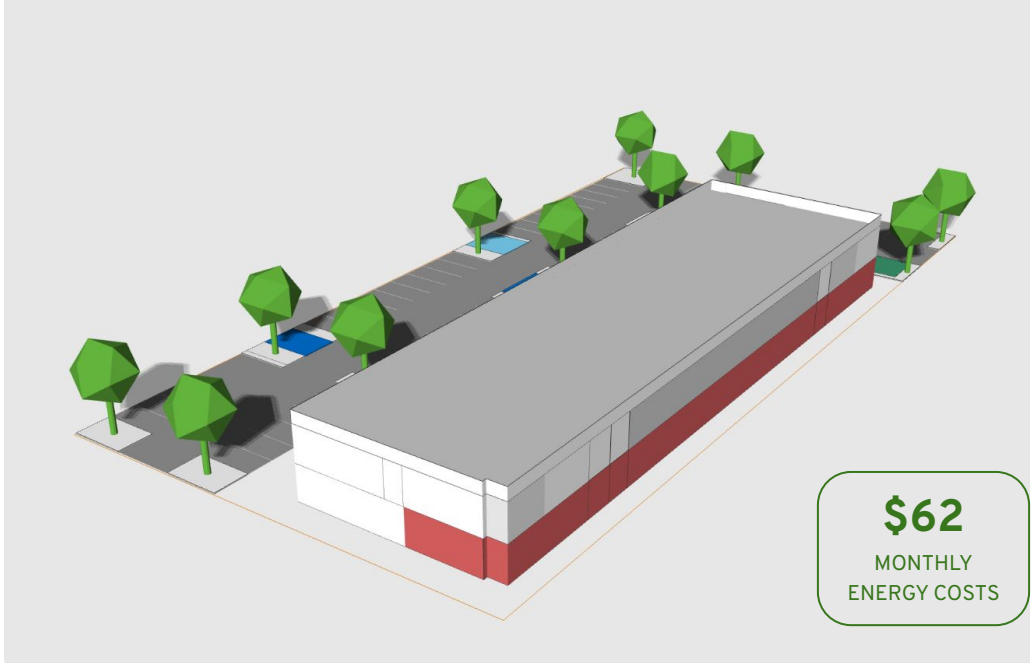
115%
MIN RENTER AMI
% of area median



CB Zone: By-Right

Apartments/Condos, Surface Parking

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	1.0
LOT AREA sf, average	7,000 min	45,000
DWELLING UNITS	--	28
AVG. UNIT SIZE sf	--	680
UNIT DENSITY units/ac	29.0 max	27.1
BEDROOM DENSITY bedrooms/ac	72.5 max	37.8
COMMERCIAL SPACE gross sf	--	6,168
BUILDING HEIGHT ft	60 max	27
BUILDING FOOTPRINT % of site sf	--	34%
FLOOR AREA RATIO gross sf/site sf	--	0.66
COMMON SPACE % of site sf	15%	27%
PARKING SPACES total	--	68
RES. PARKING RATIO per unit	1.67 min	1.67
COM. PARKING RATIO per 300 sf	1.0 min	1.0



$62
MONTHLY ENERGY COSTS

$3,400
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$138,500
MIN RENTER INCOME
rent < 30%

132%
MIN RENTER AMI
% of area median

$435,200
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

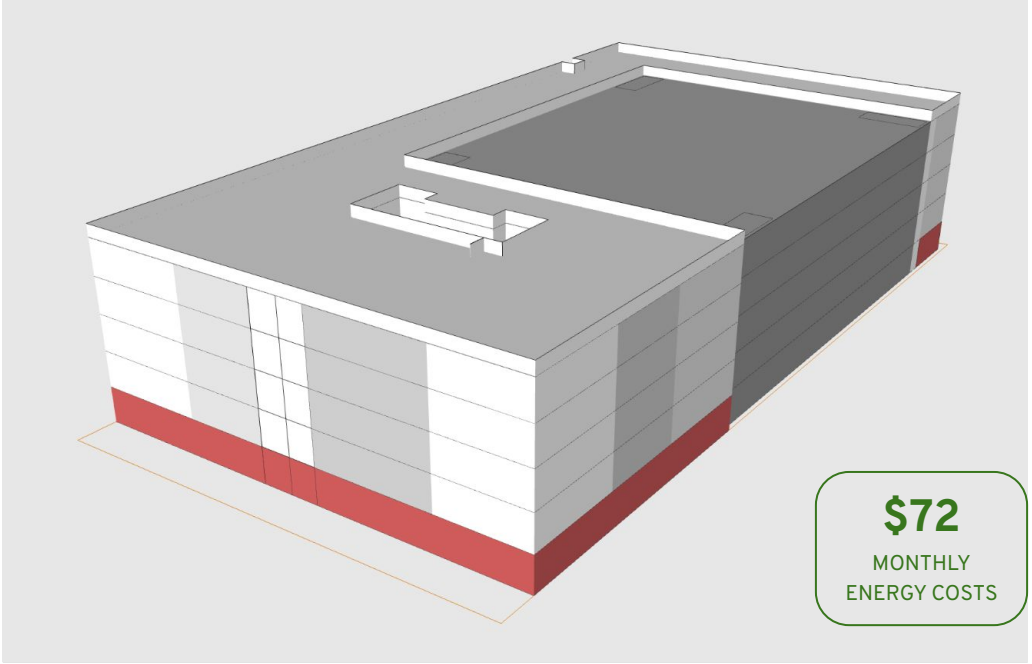
$134,000
MIN OWNER INCOME
mortgage < 30%

128%
MIN OWNER AMI
% of area median

CB Zone: HOH

Apartments/Condos, Structured Parking

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	1.0
LOT AREA sf, average	7,000 min	45,000
DWELLING UNITS	--	94
AVG. UNIT SIZE sf	--	781
UNIT DENSITY units/ac	29.0 max	91.0
BEDROOM DENSITY bedrooms/ac	72.5 max	152.0
COMMERCIAL SPACE gross sf	--	8,977
BUILDING HEIGHT ft	60 max	60
BUILDING FOOTPRINT % of site sf	--	85%
FLOOR AREA RATIO gross sf/site sf	--	2.61
COMMON SPACE % of site sf	15%	15%
PARKING SPACES total	--	189
RES. PARKING RATIO per unit	1.65 min	1.65
COM. PARKING RATIO per 300 sf	1.0 min	1.0



$72
MONTHLY ENERGY COSTS

$3,880
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$554,400
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

$157,500
MIN RENTER INCOME
rent < 30%

150%
MIN RENTER AMI
% of area median

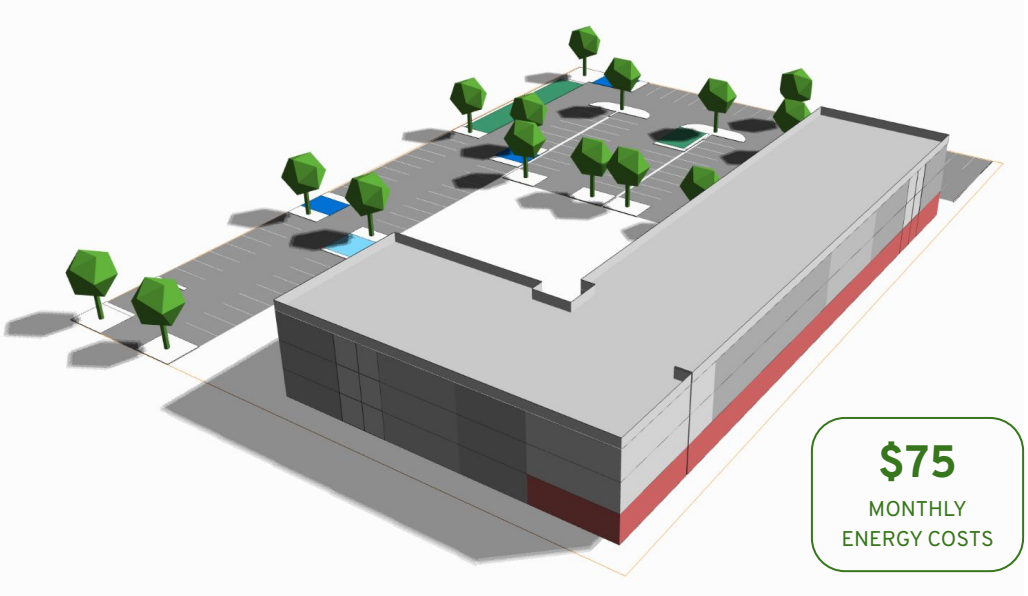
$170,000
MIN OWNER INCOME
mortgage < 30%

162%
MIN OWNER AMI
% of area median

CC/HC Zones: By-Right

Apartments/Condos, Surface Parking

PHYSICAL METRICS	CODE REQ.		PROTOTYPE
SITE AREA acre(s)	--		2.0
LOT AREA sf, average	9,000	min	87,120
DWELLING UNITS	--		55
AVG. UNIT SIZE sf	--		815
UNIT DENSITY units/ac	29.0	max	27.5
BEDROOM DENSITY bedrooms/ac	72.5	max	47.5
COMMERCIAL SPACE gross sf	--		7,025
BUILDING HEIGHT ft	60	max	40
BUILDING FOOTPRINT % of site sf	--		34%
FLOOR AREA RATIO gross sf/site sf	2.5/3.0		0.70
COMMON SPACE % of site sf	15%		35%
PARKING SPACES total	--		117
RES. PARKING RATIO per unit	1.72	min	1.72
COM. PARKING RATIO per 300 sf	1.0	min	1.0



$75
MONTHLY ENERGY COSTS

$3,450
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$140,400
MIN RENTER INCOME
rent < 30%

134%
MIN RENTER AMI
% of area median

$490,300
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

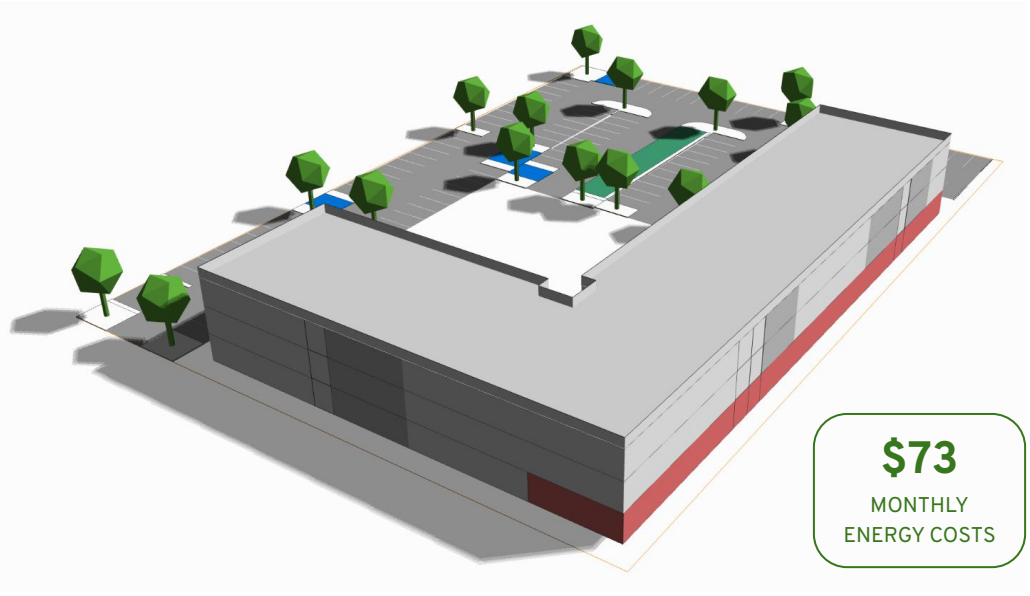
$151,000
MIN OWNER INCOME
mortgage < 30%

144%
MIN OWNER AMI
% of area median

CC/HC Zones + Affordable Incentives

Category 1, 12% Affordable Units

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	2.0
LOT AREA sf, average	9,000 min	87,120
DWELLING UNITS	--	67
AVG. UNIT SIZE sf	--	796
UNIT DENSITY units/ac	29.0 max	33.5
BEDROOM DENSITY bedrooms/ac	72.5 max	54.5
COMMERCIAL SPACE gross sf	--	7,139
BUILDING HEIGHT ft	60 max	40
BUILDING FOOTPRINT % of site sf	--	26%
FLOOR AREA RATIO gross sf/site sf	2.5/3.0	0.80
COMMON SPACE % of site sf	15%	31%
PARKING SPACES total	--	131
RES. PARKING RATIO per unit	1.43 min	1.43
COM. PARKING RATIO per 300 sf	1.0 min	1.0

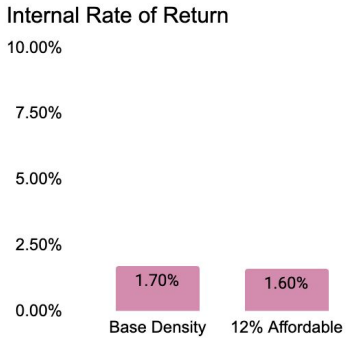


$73
MONTHLY ENERGY COSTS

$3,360
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$137,000
MIN RENTER INCOME
rent < 30%

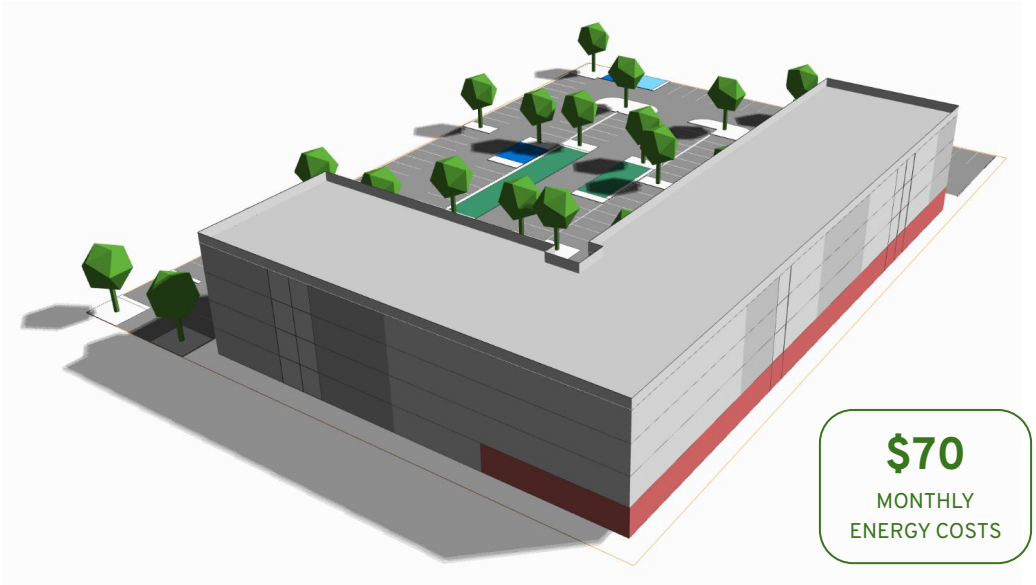
130%
MIN RENTER AMI
% of area median



CC/HC Zones + Affordable Incentives

Category 1, 20% Affordable Units

PHYSICAL METRICS	CODE REQ.	PROTOTYPE
SITE AREA acre(s)	--	2.0
LOT AREA sf, average	9,000 min	87,120
DWELLING UNITS	--	83
AVG. UNIT SIZE sf	--	870
UNIT DENSITY units/ac	29.0 max	41.5
BEDROOM DENSITY bedrooms/ac	72.5 max	68.5
COMMERCIAL SPACE gross sf	--	7,346
BUILDING HEIGHT ft	60 max	50
BUILDING FOOTPRINT % of site sf	--	24%
FLOOR AREA RATIO gross sf/site sf	2.5/3.0	1.08
COMMON SPACE % of site sf	15%	25%
PARKING SPACES total	--	147
RES. PARKING RATIO per unit	1.39 min	1.39
COM. PARKING RATIO per 300 sf	1.0 min	1.0

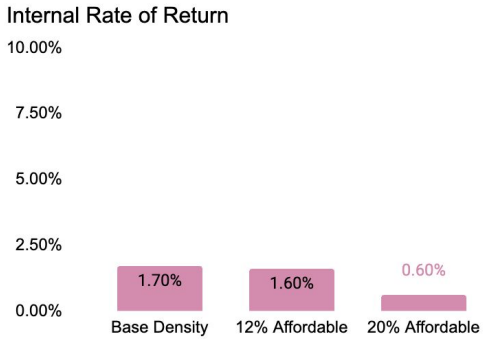


$70
MONTHLY ENERGY COSTS

$3,620
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$153,000
MIN RENTER INCOME
rent < 30%

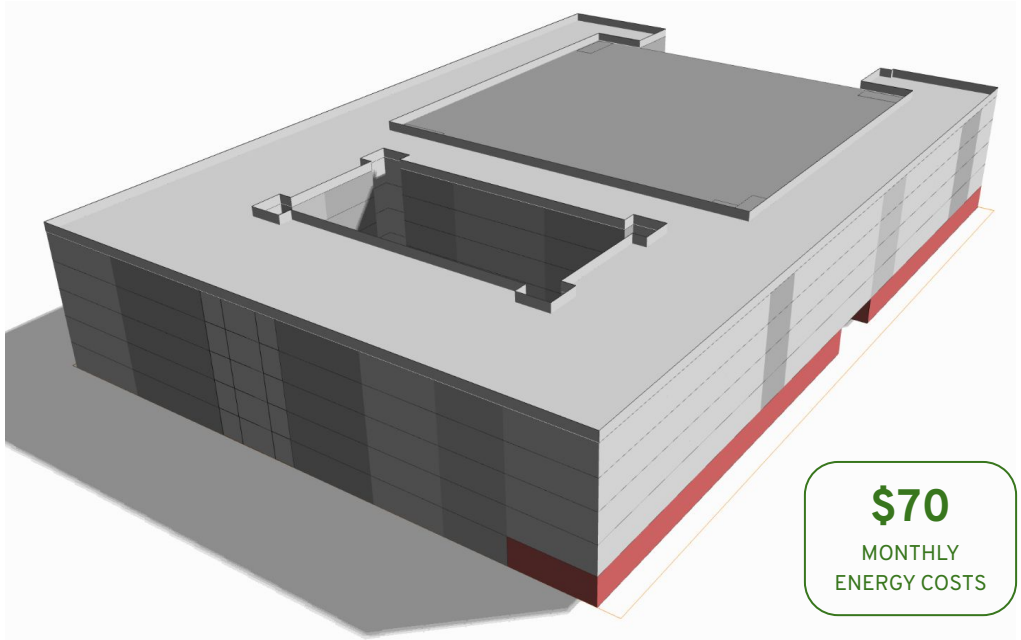
146%
MIN RENTER AMI
% of area median



CC/HC Zones: HOH

Apartments/Condos, Structured Parking

PHYSICAL METRICS	CODE REQ.		PROTOTYPE
SITE AREA acre(s)	--		2.0
LOT AREA sf, average	9,000	min	87,120
DWELLING UNITS	--		217
AVG. UNIT SIZE sf	--		766
UNIT DENSITY units/ac	29.0	max	108.5
BEDROOM DENSITY bedrooms/ac	72.5	max	180.0
COMMERCIAL SPACE gross sf	--		8,460
BUILDING HEIGHT ft	60	max	60
BUILDING FOOTPRINT % of site sf	--		81%
FLOOR AREA RATIO gross sf/site sf	2.5/3.0		2.45
COMMON SPACE % of site sf	15%		19%
PARKING SPACES total	--		397
RES. PARKING RATIO per unit	1.65	min	1.65
COM. PARKING RATIO per 300 sf	1.0	min	1.0



$70
MONTHLY ENERGY COSTS

$3,550
MIN FEASIBLE RENT
rent @ target return (10% IRR)

$150,100
MIN RENTER INCOME
rent < 30%

143%
MIN RENTER AMI
% of area median

$532,100
MIN FEASIBLE SALE PRICE
price @ target return (15% ROR)

$165,900
MIN OWNER INCOME
mortgage < 30%

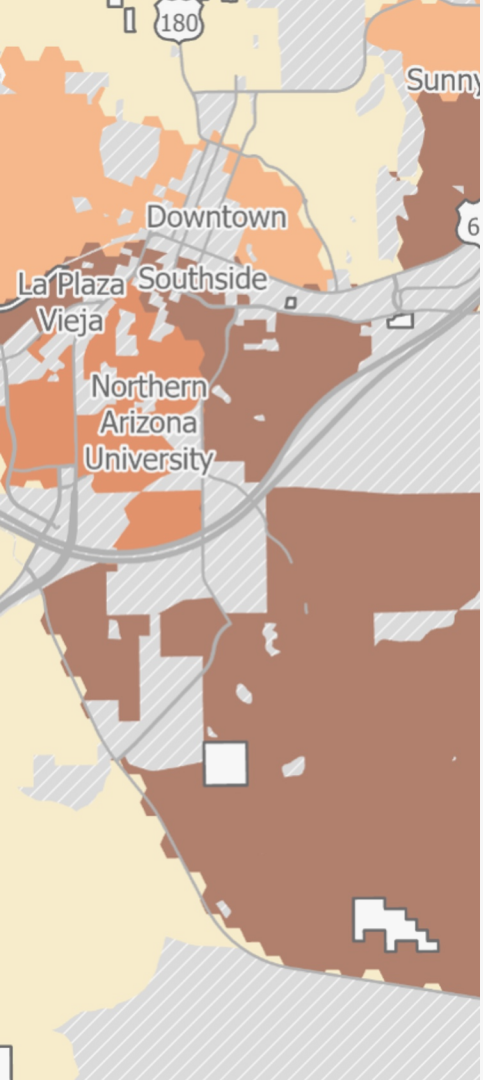
158%
MIN OWNER AMI
% of area median

APPENDIX 4.2

EQUITY AND DISPLACEMENT VULNERABILITY ASSESSMENT

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT–
DEVELOPMENT CODE DIAGNOSIS REPORT



Displacement Vulnerability and Gentrification Risk Assessment

City of Flagstaff LASS/Code Analysis Project

DECEMBER 15, 2023

Background

The removal of regulatory barriers on development, in some locations and contexts, can have the unintended consequence of **accelerating** pre-existing processes of residential displacement and gentrification.

Displacement can occur in two ways:

Physical displacement occurs when existing residents are forced to move because a property is being redeveloped, renovated, or converted to a new use.

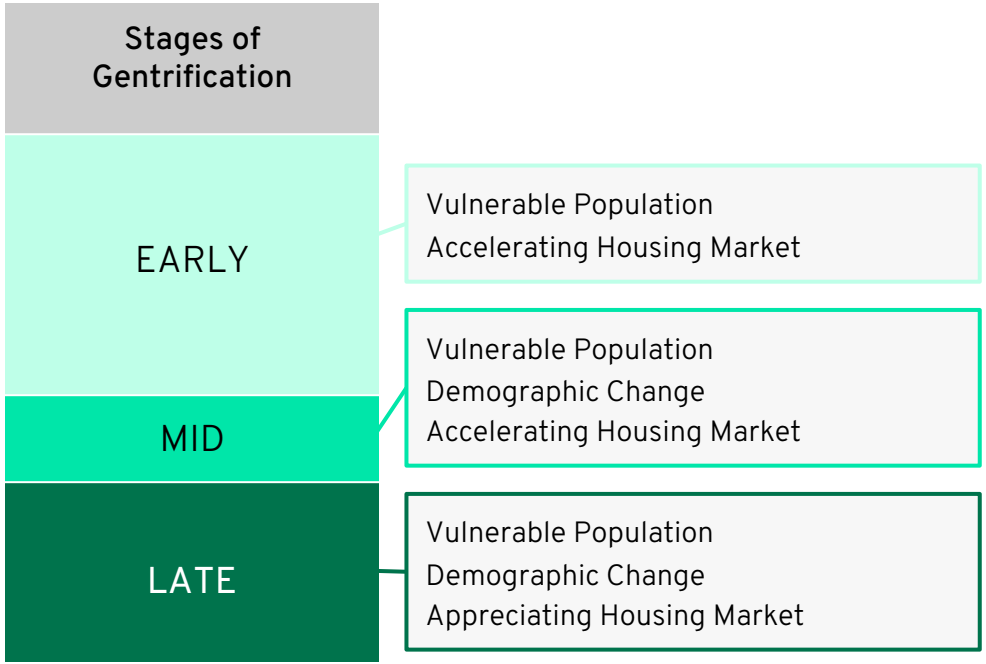
Economic displacement occurs when market conditions in the area cause rents to increase to a point that an existing resident is forced to move because they cannot afford increases in housing costs.

The City does not currently have a comprehensive, data-driven analysis that identifies the neighborhoods within the City where new development could potentially contribute to appreciating prices/rents and accelerate economic displacement.

Background

Building on academic research from Dr. Lisa Bates at Portland State University, this analysis applies a methodology that classifies neighborhoods by stage of gentrification and vulnerability to displacement.

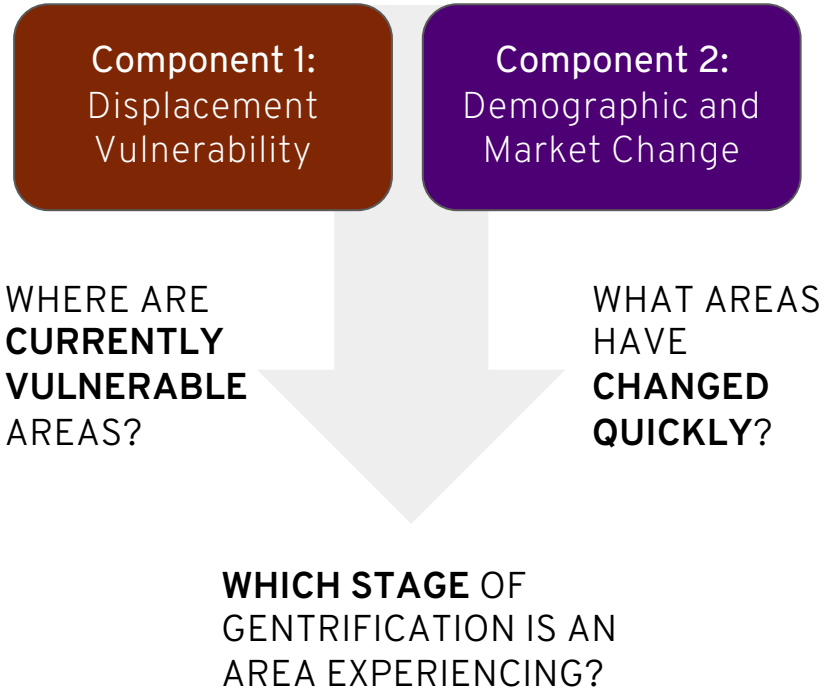
When **displacement** is associated with a broader pattern of **demographic and housing market changes** across a neighborhood, this is known as gentrification.



Methodology

To assess the stages of gentrification, we need to know which areas are currently vulnerable to future change and which areas have already experienced rapid change.

There are two components of analysis that help assess the stage of gentrification.



Two Components: Vulnerability and Change

WHERE ARE **CURRENTLY VULNERABLE** AREAS?

Component 1: Displacement Vulnerability

Demographic Characteristics: Census tract compared to citywide average to assess relative vulnerability

- Race & Ethnicity
- Housing Tenure
- Education
- Income

Displacement Vulnerability Score

WHAT AREAS HAVE **CHANGED QUICKLY**?

Component 2: Demographic and Market Change

Demographic Change Index: Change over time 2011 - 2021 using demographic characteristics

- Race & Ethnicity
- Housing Tenure
- Education
- Income

Housing Market Change Index: Change over time 2011 - 2021 in median home value and median gross rent

- Median Rent
- Median Home Value

Demographic & Market Change Index

Component 1 | Displacement Vulnerability

WHERE ARE **CURRENTLY VULNERABLE** AREAS IN FLAGSTAFF?

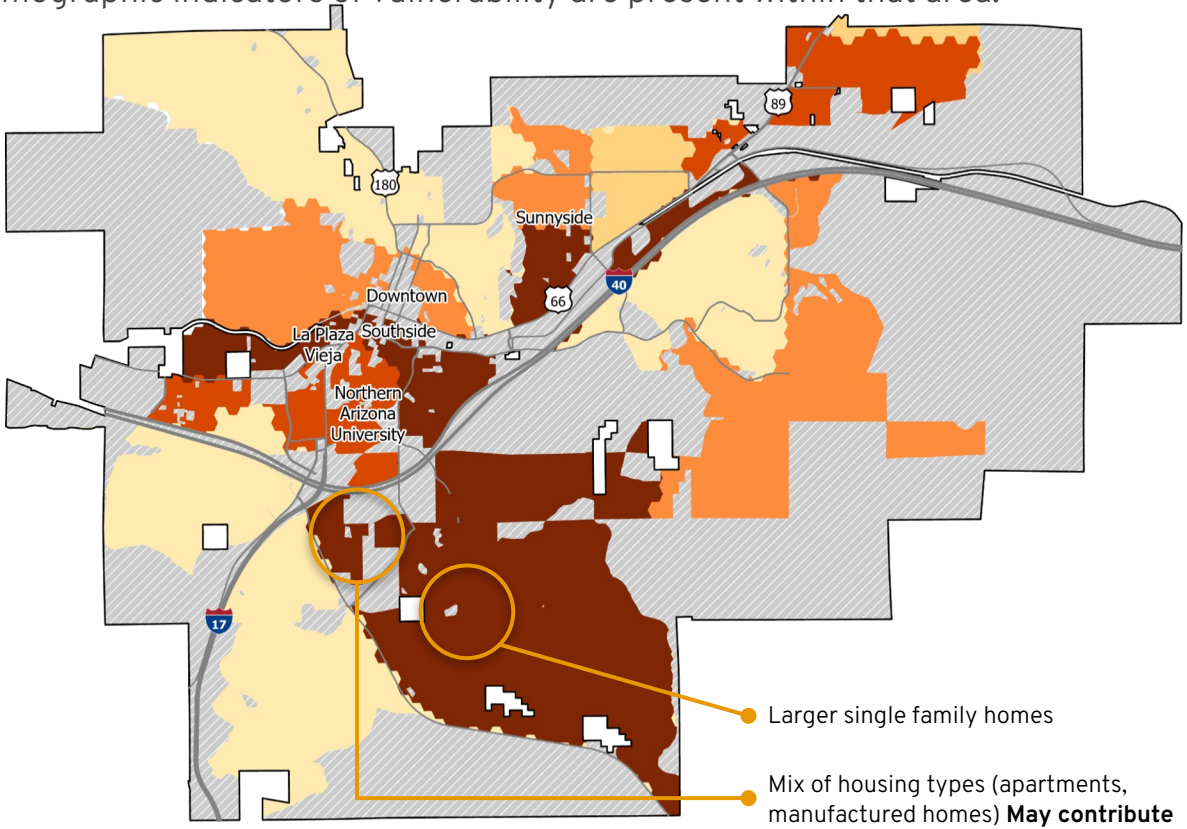
Race & Ethnicity	% People of Color
Housing Tenure	% Renter Population
Educational Attainment	% Population without a Bachelor's Degree
Income	% Population with Yearly Income Below 80% AMI

METHODOLOGY

1. What is the City median?
2. Is the tract below or above the City median?
3. If higher, tract is coded as vulnerable

Displacement Vulnerability Index - 2021

This index shows different levels of vulnerability. The darker the color, the more demographic indicators of vulnerability are present within that area.



Number of Vulnerable Indicators

Less Vulnerable

0

1

2

3

More Vulnerable

4

Low Population

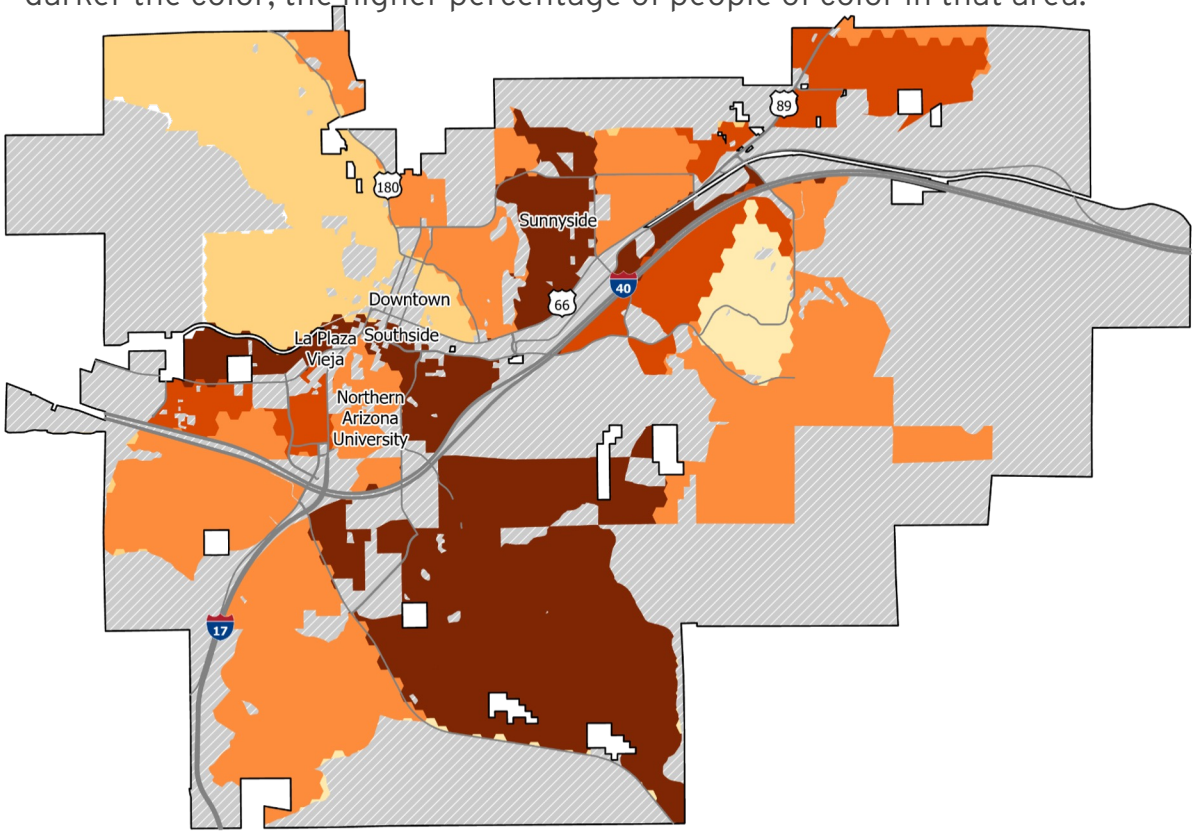
Measured by:

- % People of Color
- % Renters
- % Without a Bachelor's
- % <= 80% AMI

2021 ACS 5-YR

Race & Ethnicity Vulnerability - 2021

This map shows percentage of the population who are people of color. The darker the color, the higher percentage of people of color in that area.



Percent of Population who are People of Color

Less POC

- Less than 14%
- 14% - 24%
- 24% - 37%

City Median ***37%***

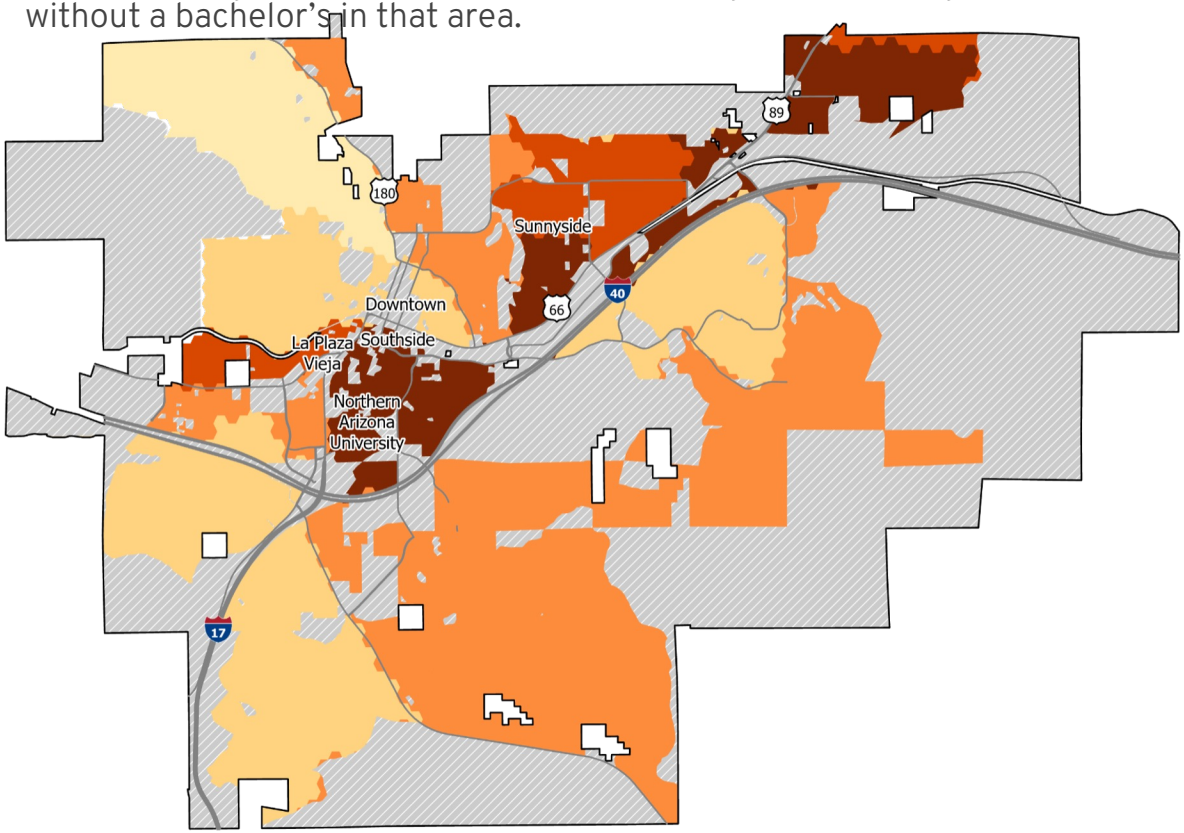
- 37% - 43%
- More than 43%
- Low Population

More POC

2021 ACS 5-YR

Education Vulnerability - 2021

This map shows percentage of the population who are have less than a bachelor's degree. The darker the color, the higher percentage of those without a bachelor's in that area.



Percent of Population without a Bachelor's Degree

More with a Bachelor's

- Less than 34%
- 34% - 43%
- 43% - 49%

City Median ***49%***

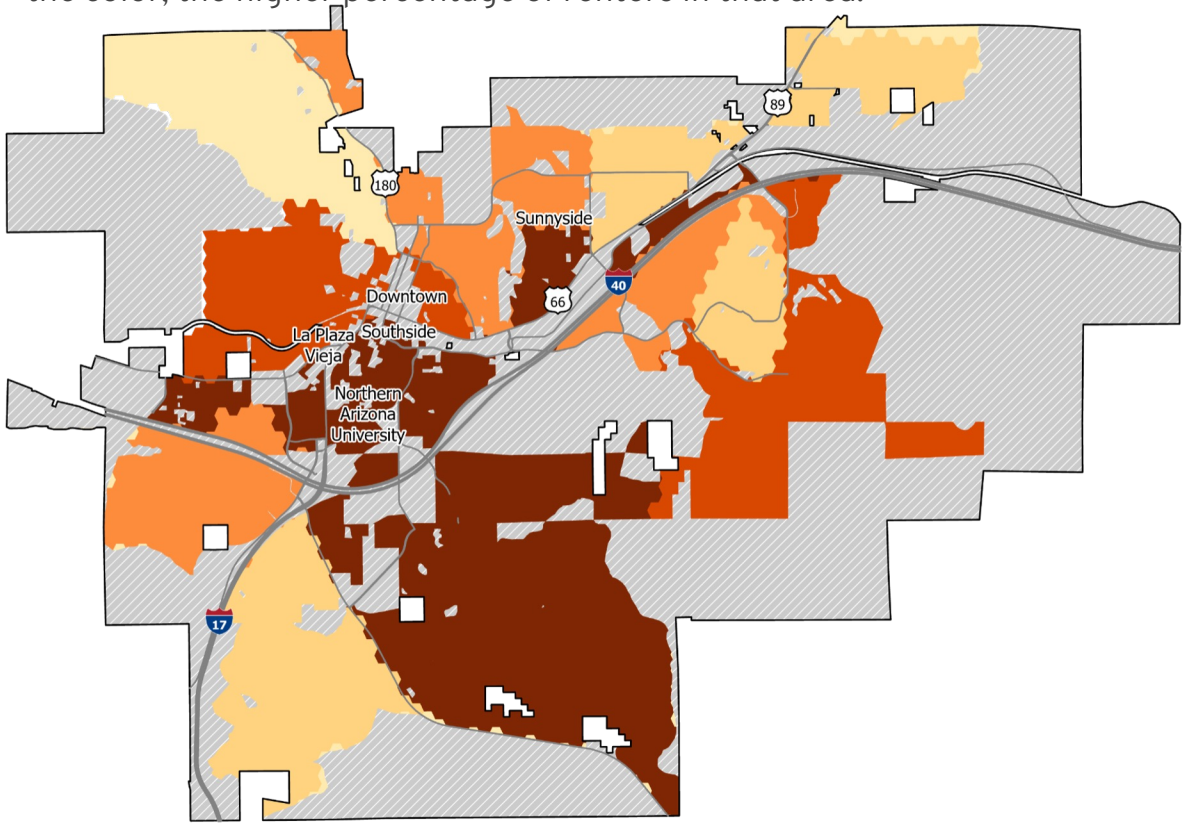
- 49% - 64%
- More than 64%
- Low Population

Less with a Bachelor's

2021 ACS 5-YR

Renter Share of Population - 2021

This map shows percentage of the population who are renters. The darker the color, the higher percentage of renters in that area.



Percent of Population who are Renters

Less Renters

- Less than 25%
- 25% - 40%
- 40% - 55%

City Median ***55%***

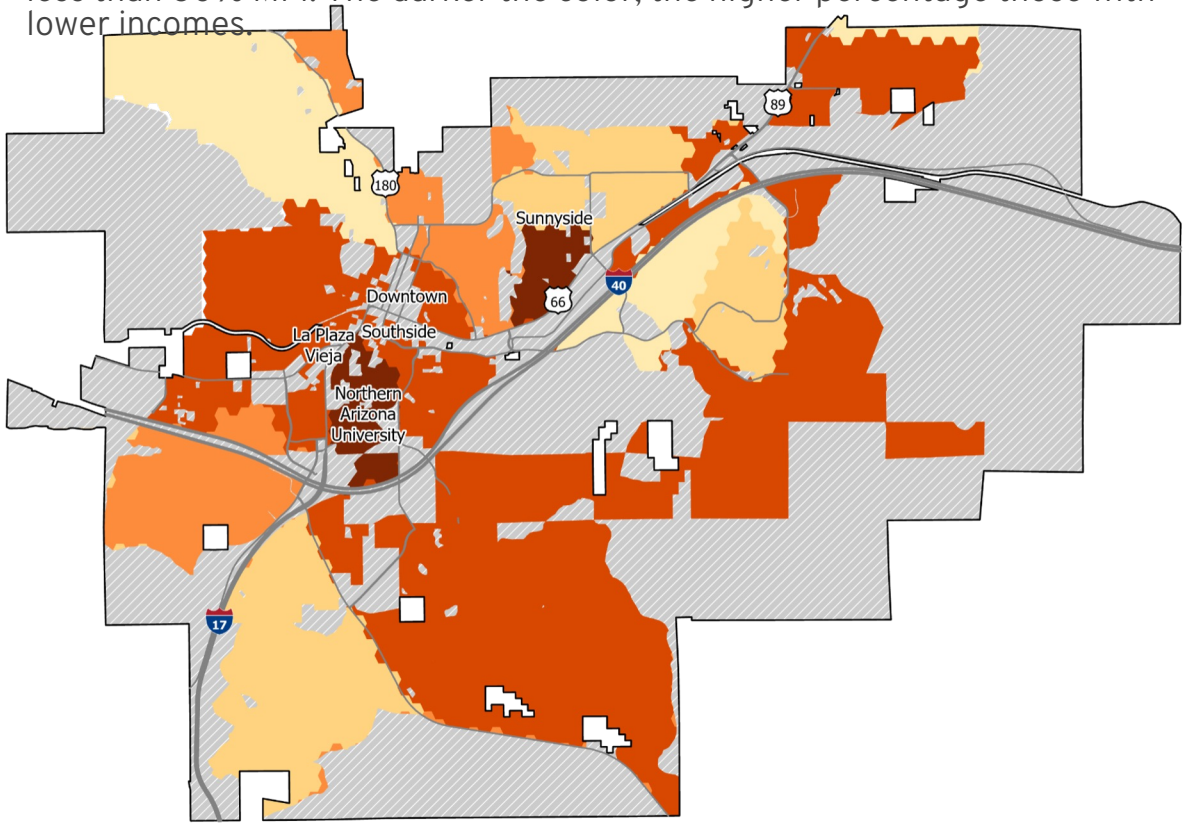
- 55% - 65%
- More than 65%
- Low Population

More Renters

2021 ACS 5-YR

Low Income Share of Population - 2021

This map shows percentage of the population who have incomes equal to or less than 80% MFI. The darker the color, the higher percentage those with lower incomes.



Percent of Population who have incomes ≤80% MFI

Higher Incomes

Less than 29%

29% - 38%

38% - 50%

City Median ***55%***

50% - 75%

More than 75%

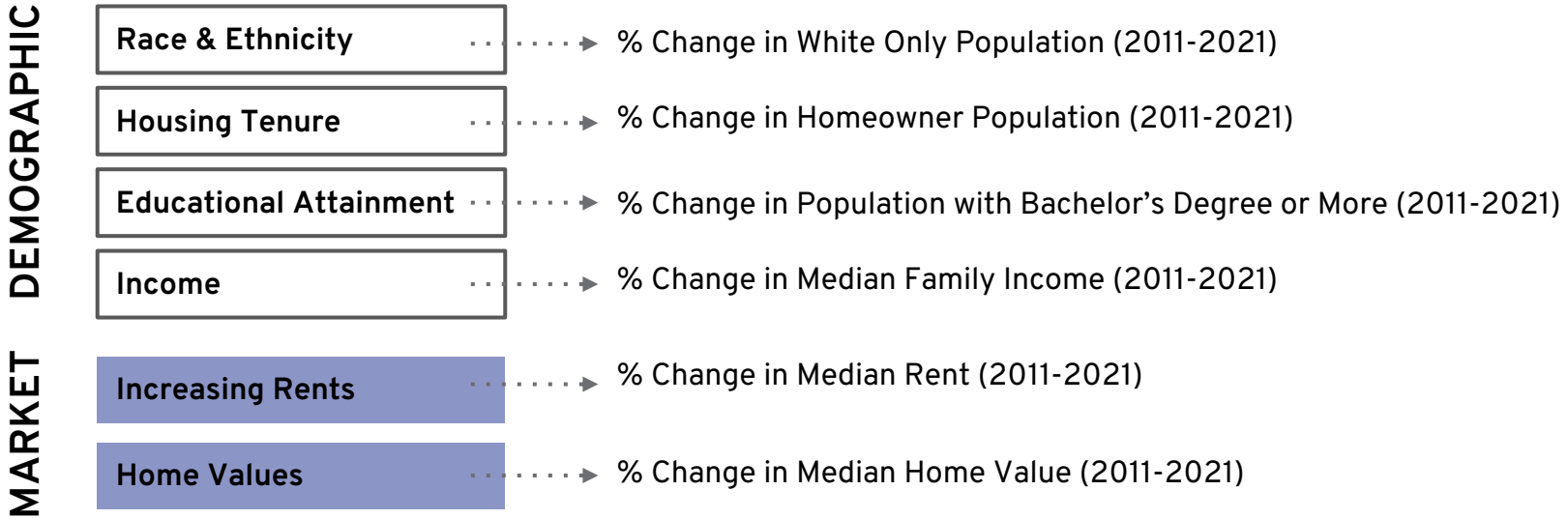
Low Population

Lower Incomes

2021 ACS 5-YR

Component 2 | Demographic & Market Change

WHAT AREAS HAVE **CHANGED QUICKLY** IN FLAGSTAFF?

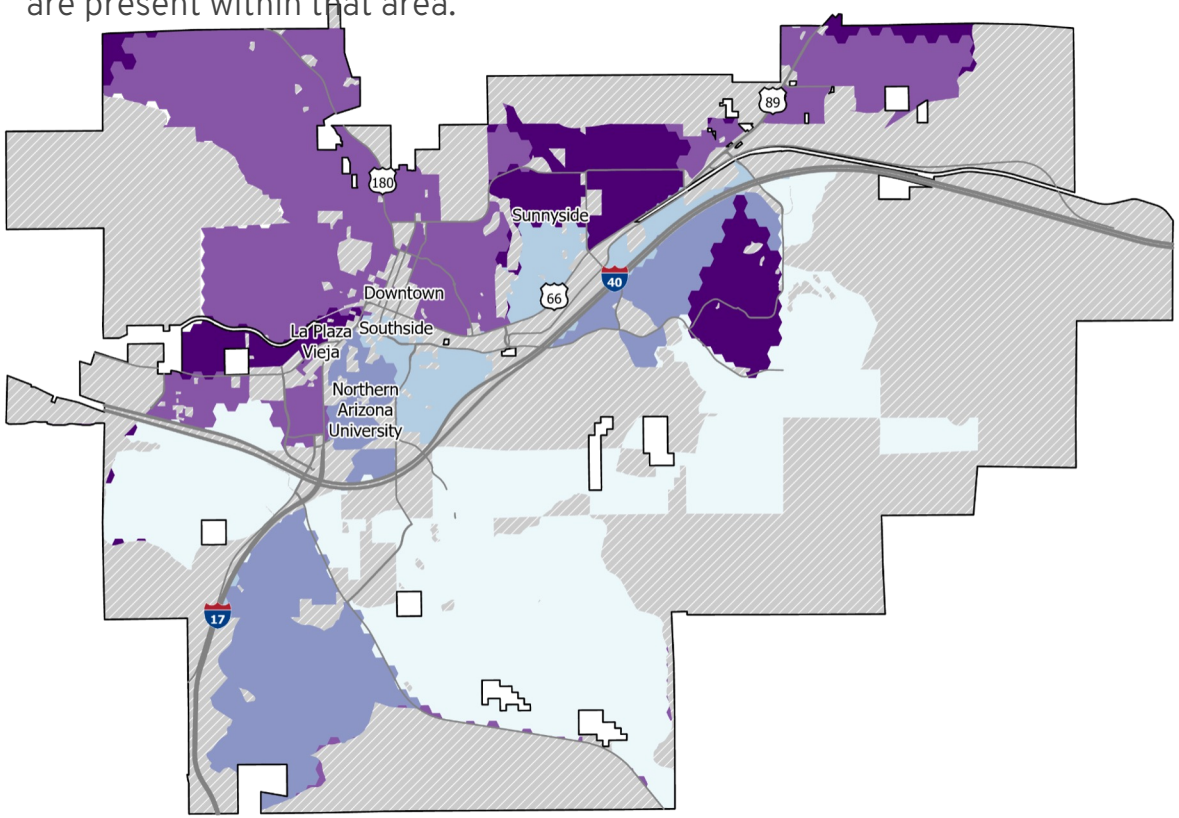


METHODOLOGY

1. What is the City median?
2. Is the tract below or above the City median?
3. If yes, tract is coded as vulnerable

Demographic Change Index - (2011-2021)

This index shows different levels of demographic change towards gentrification. The darker the color, the more demographic changes indicative of gentrification are present within that area.



Number of Demographic Indicators that Changed Towards Gentrification

Less Gentrification

- Change in 0 Indicators
- Change in 1 Indicator
- Change in 2 Indicators
- Change in 3 Indicators
- Change in 4 Indicators

More Gentrification

- Low Population

Measured by:

- Increase in White Only Population
- Increase in Homeowners
- Increase in Bachelor's Degrees or More
- Increase in Median Household Income

2011 and 2021 ACS 5-YR

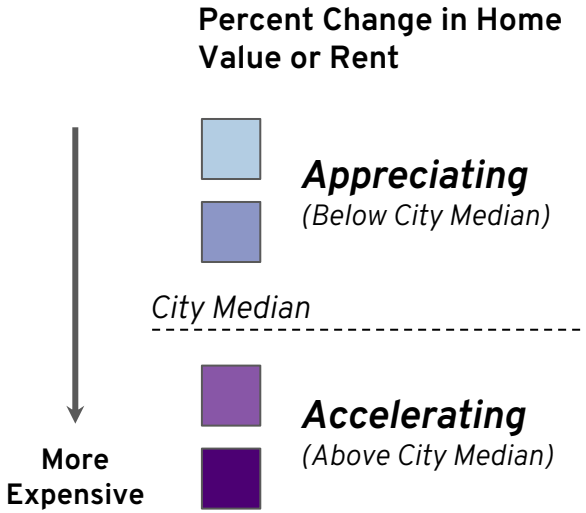
Housing Market Change

We looked at the trend of median home values and rent costs over time to determine gentrification related housing pressures in each tract.

These market conditions are defined in two housing market types:

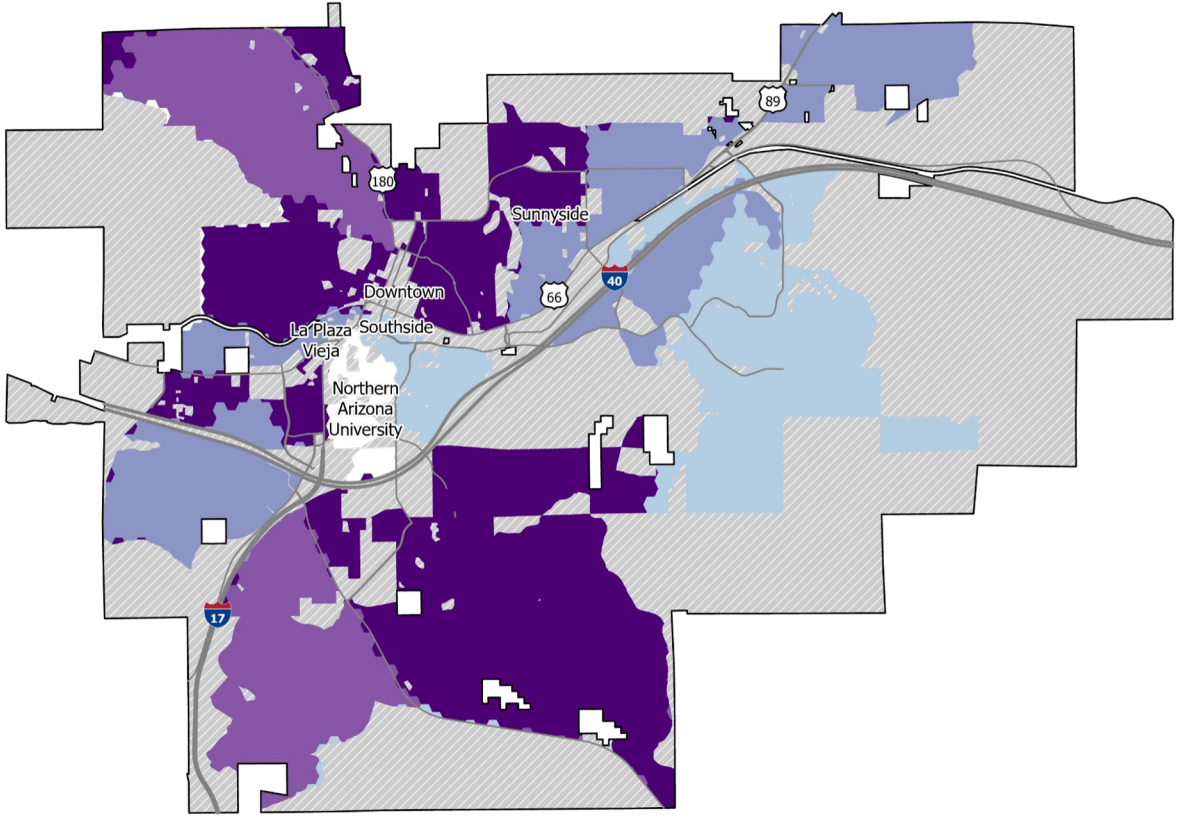
Accelerating: tract experienced rapid appreciation rates over the last decade, above city median home values and rent cost. *(Values greater than the city median)*

Appreciating: tract experienced high appreciation rates over the last decade, but not as rapid as accelerating. *(Values greater than 0, and below the city median)*



Home Value Appreciation - (2011-2021)

This map shows percentage change in home value. The darker the color, the higher percentage change of home value in the area.



Percent Change in Home Value

Appreciating[1]
- Less than 0%
- 0% - 11%

City Median ---------- 11%

Accelerating[2]
- 11% - 20%
- More than 20%

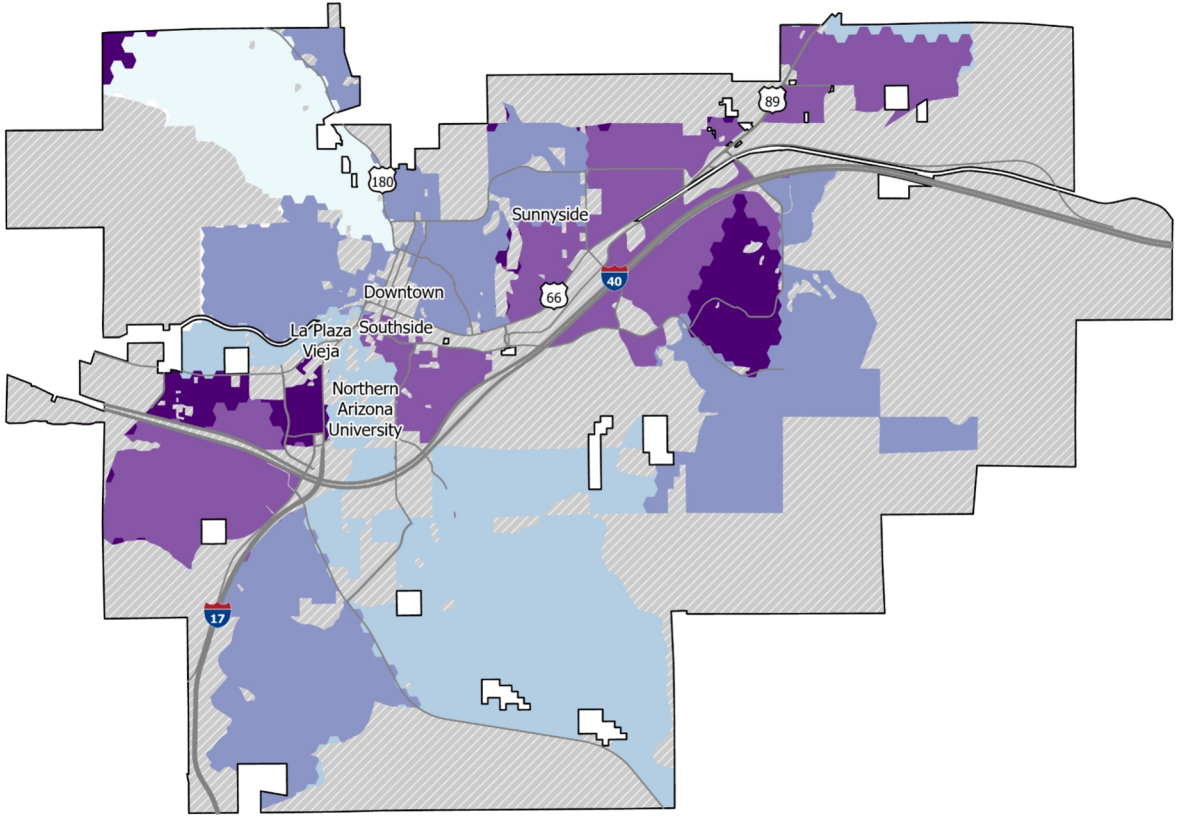
- Low Population

[1] *Values greater than 0 and below the City median*
[2] *Values greater than the City median*

2011 and 2021 ACS 5-YR

Rent Cost Appreciation - (2011-2021)

This map shows percentage change in rent price. The darker the color, the higher percentage of rent change in the area.



Percent Change in Rent Price

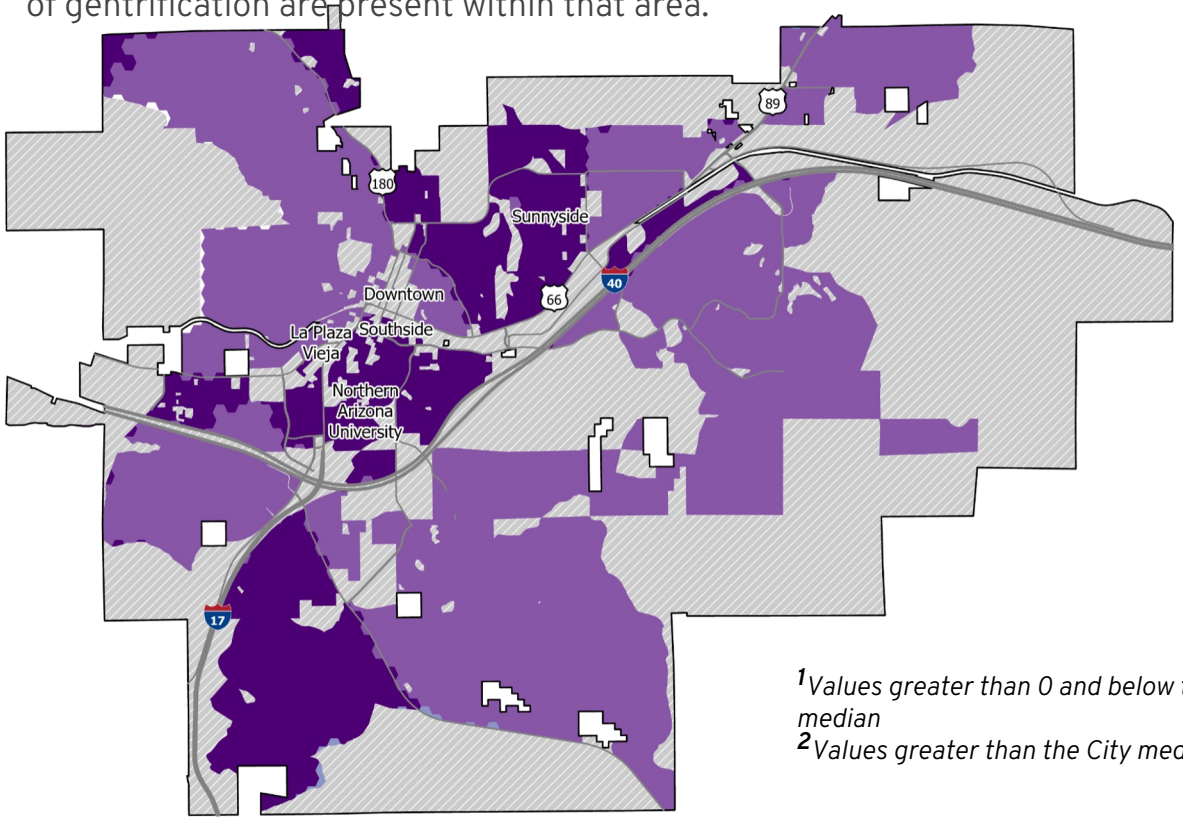
- Less than 0%
- Appreciating[1]
  - 0% - 10%
  - 10% - 20%
- *City Median* ***20%***
- Accelerating[2]
  - 20% - 38%
  - More than 38%
- Low Population

[1] *Values greater than 0 and below the City median*
[2] *Values greater than the City median*

2011 and 2021 ACS 5-YR

Housing Market Change Index - (2011-2021)

This index shows different levels of housing market change towards gentrification. The darker the color, the more housing market changes indicative of gentrification are present within that area.



[1] *Values greater than 0 and below the City median*
[2] *Values greater than the City median*

Level of Housing Market Change

Blended average of renters and owners and changes to home values and rent

Appreciating[1]

City Median ***16.24%***

Accelerating[2]

Low Population

Measured by % change of home value or rent weighted by share of renters or owners

% Change in Rent Costs
% Change in Home Values

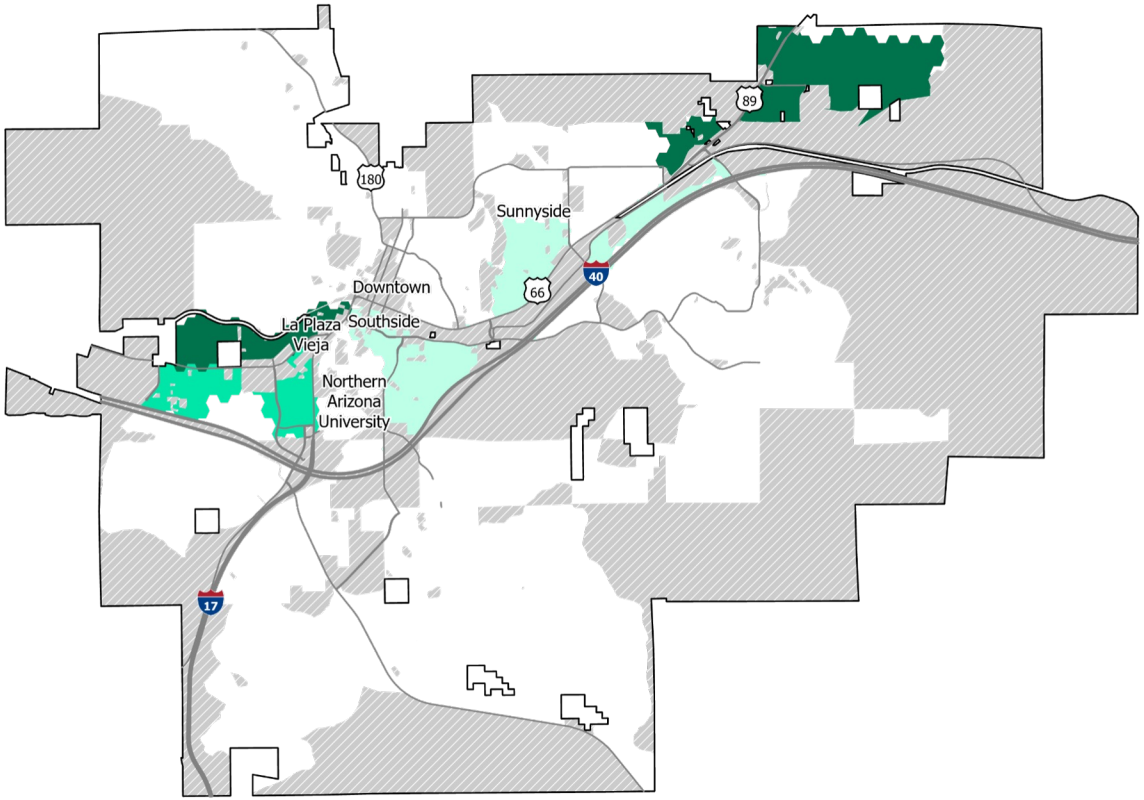
2011 and 2021 ACS 5-YR

Neighborhood Gentrification Typology

Stages of Gentrification	Vulnerable Population? *(>2 indicators)*	Demographic Change? *(>2 indicators)*	Housing Market Condition
EARLY Rapid market changes and currently vulnerable population. No major demographic changes yet.	Yes	No	Accelerating
MID Gentrification and displacement actively occurring with demographic change and high appreciation in housing costs apparent.	Yes	Yes	Accelerating
LATE Gentrification and displacement is occurring and is attracting a more white, college educated demographic	Yes	Increasing rates of white and college educated	Appreciating

Neighborhood Gentrification Typology

This index shows neighborhood typologies based on Early, Mid, and Late stages of gentrification.



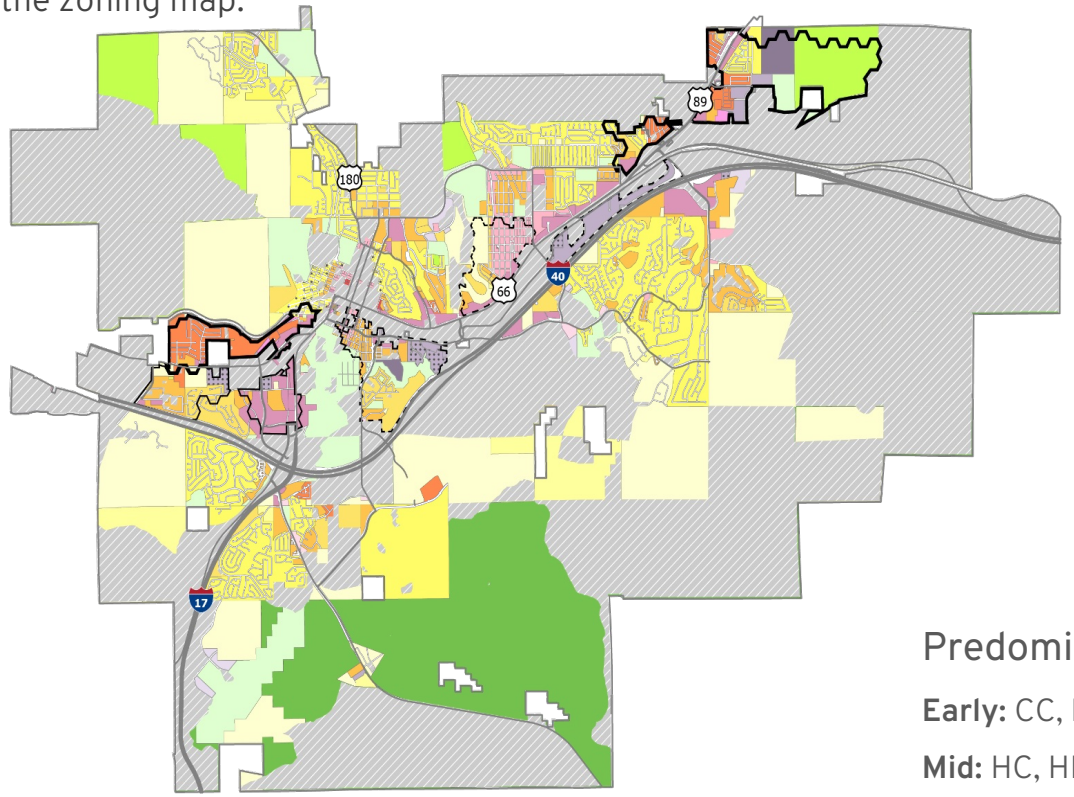
- Early
- Mid
- Late
- Low Population

The Code Diagnostic Report will evaluate if existing zoning and development regulations may be contributing to displacement and gentrification pressures in these areas.

This data will be used to evaluate the impacts of recommended code changes on displacement or gentrification pressures.

Neighborhood Gentrification Typology

This map shows the neighborhood gentrification typologies overlayed on the zoning map.



Predominant zones:

Early: CC, HR, MR, RR

Mid: HC, HR, MR

Late: MH, R1, HC

City Zoning

Residential Zones:
- Rural Residential (RR)
- Estate Residential (ER)
- Single-family Residential (R1)
- Single-family Residential Neighborhood (R1N)
- Medium Density Residential (MR)
- High Density Residential (HR)
- Manufactured Housing (MH)

Transect Zones:
- T3N.1
- T4N.1
- T4N.1-O
- T5
- T5-O
- T6

Commercial Zones:
- Central Business (CB)
- Highway Commercial (HC)
- Commercial Service (CS)
- Community Commercial (CC)
- Suburban Commercial (SC)

Industrial Zones:
- Research and Development (RD)
- Light Industrial (LI)
- Light Industrial Open (LI-O)
- Heavy Industrial (HI)
- Heavy Industrial Open (HI-O)

Resource and Open Space:
- Public Facility (PF)
- Public Lands Forest (PLF)
- Public Open Space (POS)

Neighborhood Typology (Gentrification):
- Late
- Mid
- Early

Low Population

APPENDIX **5.1**

ZERO CODE TOOL - SAMPLE REPORT

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT–
DEVELOPMENT CODE DIAGNOSIS REPORT

ABOUT YOUR BUILDING

Code Pathway: ○ Prescriptive ○ Performance

Standard	ZERO Code 2.0 *
Country	United States *
State	Arizona
City	Flagstaff *
Number of Stories	3 *
Add Another Use	*

Selected Use Type(s):

Apartment

APARTMENT

delete

Gross Floor Area: 73500 * sq.ft *

ON-SITE PV SYSTEMS

Enter on-site PV system generation potential below, or estimate on-site PV system generation potential using PVWatts. If your building has multiple PV systems enter them below.

○ Use PVWatts ○ Enter Generation Potential

Set Default Values delete

Estimated Area for Collectors	12250 * sq.ft *
Module Type	Standard *
Losses (%)	14 *
Array Type	Fixed - Roof Mounted *
Tilt (Degrees)	22.6 *
Azimuth (Degrees)	180 *
Inverter Efficiency (%)	96 *

Add another PV System

GENERATE RESULTS →

RESULTS

○ metric ○ imperial

RENEWABLE ENERGY REQUIREMENTS

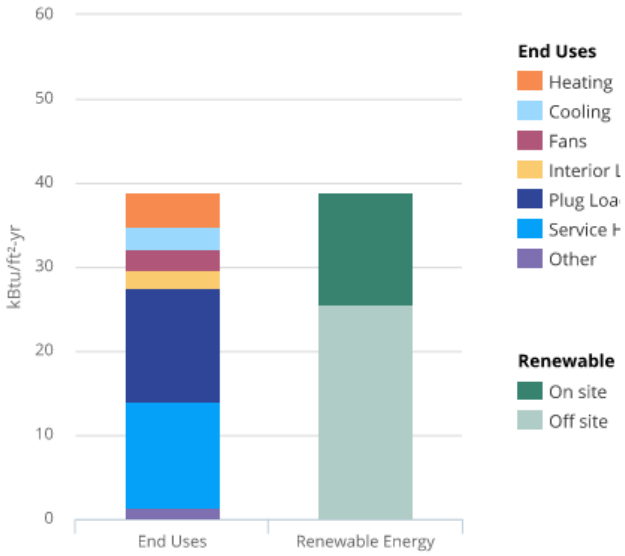
Energy Consumption & Generation

	kBtu/ft²-yr	MBtu/yr
Estimated Building Energy Consumption	**38.8**	**2,850.8**
Total Renewable Energy Required	**38.8**	**2,850.8**
On-Site PV Generation Potential	13.4	985.6
Remaining Off-Site Procured Renewable Energy	25.4	1,865.2

On-Site PV System

Rated Capacity (kW)	171
Estimated Area for Collectors (ft²)	12,250

ESTIMATED BUILDING ENERGY CONSUMPTION



Building Energy Consumption and End Uses are based on a **code compliant prototype building** modeled by Pacific Northwest National Laboratory. Actual building energy consumption will vary from modeled results.

Estimated Site EUI: **38.79** kBtu/ft²-yr

Estimated Energy Consumption: **2,850.76** MBtu/yr

End Use	Subtotal (kBtu/ft²-yr)	Percent
Heating	**4.12**	10.62%
Cooling	**2.57**	6.63%
Interior Lighting	**2.33**	6.01%
Plug Loads	**13.53**	34.90%
Service Hot Water	**12.57**	32.40%
Fans	**2.37**	6.10%
Other		
Exterior Equipment	**0.08**	0.21%
Exterior Light	**1.03**	2.65%
Heat Rejection	**0.01**	0.03%
Pumps	**0.18**	0.46%
Total	**38.79**	**100.00%**

APPENDIX **p.2**

CODE IMPROVEMENT SECTIONS

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT–
DEVELOPMENT CODE DIAGNOSIS REPORT

Excerpt from IECC 2021 Section C405 – Air Leakage

C402.5.2 Dwelling and Sleeping Unit Enclosure Testing

The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the *code official*. The measured air leakage shall not exceed 0.30 cfm/ft^2 (1.5 L/s m^2) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one *building thermal envelope*, each unit shall be considered an individual testing unit, and the building air leakage shall be the weighted average of all testing unit results, weighted by each testing unit's enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

1. Where buildings have fewer than eight testing units, each testing unit shall be tested.
2. For buildings with eight or more testing units, the greater of seven units or 20 percent of the testing units in the building shall be tested, including a top floor unit, a ground floor unit and a unit with the largest testing unit enclosure area. For each tested unit that exceeds the maximum air leakage rate, an additional two units shall be tested, including a mixture of testing unit types and locations.

C402.5.3 Building Thermal Envelope Testing

The *building thermal envelope* shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.40 cfm/ft^2 (2.0 L/s × m^2) of the *building thermal envelope* area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

1. The entire envelope area of all stories that have any spaces directly under a roof.
2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
3. Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured air leakage rate exceeds 0.40 cfm/ft^2 (2.0 L/s × m^2) but does not exceed 0.60 cfm/ft^2 (3.0 L/s × m^2), a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section.

Revised Table from IRC 2018 Chapter 29 – Water Supply and Distribution

P2903.2 Maximum Flow and Water Consumption

The maximum water consumption flow rates and quantities for plumbing fixtures and fixture fittings shall be in accordance with Table P2903.2.

TABLE P2903.2

MAXIMUM FLOW RATES AND CONSUMPTION FOR PLUMBING FIXTURES AND FIXTURE FITTINGS[b]

PLUMBING FIXTURE OR FIXTURE FITTING	MAXIMUM FLOW RATE OR QUANTITY
Lavatory faucet	1.0 gpm at 60 psi
Shower head[a]	1.75 gpm at 80 psi
Sink faucet	1.50 gpm at 60 psi
Water closet	1.28 gallons per flushing cycle

For SI: 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

Excerpt from IECC 2021 Section C405 – Lighting

C405.1.1 Lighting for Dwelling Units

No less than 90 percent of the permanently installed lighting serving dwelling units, excluding kitchen appliance lighting, shall be provided by lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 45 lm/W, or shall comply with Sections C405.2.5 and C405.3.

Excerpt from ASHRAE 90.1-2022 Section 9.4 – Lighting

9.4.3 Dwelling Units. *Dwelling unit lamps*, *luminaires*, and lighting controls shall be installed to meet the provisions of Sections 9.4.3.1, 9.4.3.2, and 9.4.3.3. No other provisions of Section 9 apply to *dwelling units*.

9.4.3.1 Lamp and Luminaire Efficacy. At least 75% of the *permanently installed luminaires* shall use *lamps* with an *efficacy* of at least 75 lm/W or have a total *luminaire efficacy* of at least 50 lm/W.

9.4.3.2 Interior Lighting Controls. Fifty percent (50%) of *permanently installed* interior *luminaires* shall be controlled with *dimmers* or shall *automatically* be shut off within 20 minutes of all occupants leaving a *space*.

9.4.3.3 Exterior Lighting Controls. *Permanently installed* exterior *luminaires* dedicated to a *dwelling unit* shall be provided with *manual* controls and be *automatically* shut off through time of day, available daylight, or when no activity has been detected for 15 minutes.

Exception to 9.4.3.3: Applications with a total rated *luminaire* wattage of no greater than 8 W.

Excerpt from ASHRAE 90.1-2022 Section 6.5.6 – Energy Recovery

6.5.6 Energy Recovery

6.5.6.1 Exhaust Air Energy Recovery

6.5.6.1.1 Nontransient Dwelling Units. *Nontransient dwelling units* shall be provided with *outdoor air energy* recovery *ventilation systems*. For *nontransient dwelling units*, *energy* recovery *systems* shall result in an *enthalpy recovery ratio* of at least 50% at the cooling design condition.

At the heating design condition, *energy* recovery performance shall be as follows:

a. Where active humidification is provided to *spaces* served by the *system*, *energy* recovery *systems* shall result in an *enthalpy recovery ratio* of at least 60%.
b. Where active humidification is not provided to *spaces* served by the *system*, *energy* recovery *systems* shall result in a *sensible energy recovery ratio* of at least 60%.

The *energy* recovery *system* shall provide the required *enthalpy recovery ratio* or *sensible energy recovery ratio* at both heating and cooling *design conditions*, unless one mode is not required for the climate zone by the exceptions below.

Exceptions to 6.5.6.1.1:

1. *Nontransient dwelling units* in Climate Zone 3C.
2. *Nontransient dwelling units* with no more than 500 ft^2 of *gross conditioned floor area* in Climate Zone 0, 1, 2, 3, 4C, and 5C.
3. *Energy* recovery performance requirements at heating design condition in Climate Zones 0, 1, and 2.
4. *Enthalpy recovery ratio* requirements at cooling design condition in Climate Zones 4, 5, 6, 7, 8.

Excerpt from NBI IBC Recommendations – EPDs for Steel Products

International Building Code, Chapter 22 Steel
Section 2205 Structural Steel

Add new section as follows:

2205.3 EPD Disclosure. Product-specific Type III EPDs shall be submitted for 75% of steel products. EPDs used for compliance with this section shall be certified as complying with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930 and be available in a publicly accessible database.

Excerpt from NBI IBC Recommendations – Low-Carbon Concrete

International Building Code, Chapter 19 Concrete
Section 1903 Specifications for Tests and Materials

Add new section as follows:

1903.5 Embodied CO2e of concrete materials. *Concrete* products used in the building project shall be in accordance with Sections 1903.5.1 or 1903.5.2.

Exceptions:

1. Precast concrete.
2. *Masonry units* complying with Section 2103.1.2.
3. Projects where no concrete suppliers with product-specific environmental product declarations (EPD) for *concrete* are located within 100 miles of the project site, where Type III industry-wide EPDs and an inventory of CO2e values for all concrete mixes are provided to the AHJ.

1903.5.1 CO2e Limit Method - Mixture. The total CO2e of the concrete mixes used in the project shall not exceed the value given in Table 1903.5.1 based on the compressive strength of the product. CO2e content shall be documented by a product-specific Type III Environmental Product Declaration (EPD) for each product. EPDs used for compliance with this section shall be certified as complying with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930 and be available in a publicly accessible database.

Table 1903.5.1 CO2e Limits in Mixture

Specified compressive strength f'_c, psi	Maximum kg/m^3(SI)	High-early strength Maximum kg/m3 (SI)	Lightweight concrete Maximum kg/m3 (SI)
up to 2499	302	408	578
2500-3499	382	516	578
3500-4499	432	583	626
4500-5499	481	649	675
5500-6499	505	682	N/A
6500 and greater	518	680	N/A

1903.5.2CO2e Limit Method - Project. Total CO2e (CO2eproj) of all concrete placed at the building project shall not exceed the project limit (CO2eallowed) determined using Table 1903.5.1 and Equation 1903.5.2.

Equation 1903.5.2

CO2eproj < CO2Eallowed

where: CO2Eproj = ΣO2En vn and CO2Eallowed = ΣCO2Elim vn

and

n = the total number of concrete mixtures for the project

CO2En = the global warming potential for mixture n per mixture EPD, kg/m3

CO2Elim = the global warming potential limit for mixture n per Table 1903.5, kg/m3

vn = the volume of mixture n concrete to be placed

APPENDIX p.3

HEMPCRETE

CITY OF FLAGSTAFF

CODE ANALYSIS PROJECT–
DEVELOPMENT CODE DIAGNOSIS REPORT

RB316-22

IRC: AY101 (New)

Proponents: Jacob Waddell, representing US Hemp Building Association (President@ushba.org); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net); David Eisenberg, representing DCAT (strawnet@gmail.com); Mary Dempsey, representing Mpactful Ventures, PBLLC (mary@mpactfulventures.org); Anthony Dente, representing Verdant Structural Engineers (anthony@verdantstructural.com); Kiko Thébaud, representing Kiko Thébaud, Architect (kikothebaud@gmail.com); Cameron McIntosh, representing Americhanvre LLC (cameron@americhanvre.com); Matt Marino, representing Homeland Hempcrete (matt@homelandhempco.com); Anastasiya Konopitskaya, representing Coexist Build LLC (ana@coexist.build); Chris Magwood, representing Endeavour Centre (chris@endeavourcentre.org); Graham Durrant, representing Hemp-Lime Spray Limited (hemplimespray@yahoo.com); Timothy Callahan, representing Self (t.l.callahan@icloud.com); Matthew Mead, representing Hempitecture Inc. (mattie@hempitecture.com); Jennifer Martin, representing HempStone LLC (jennifer@hempstone.net); Tom Rossmassler, representing Hempstone, LLC (tom@hempstone.net); C Michael Donoghue, representing Maritech Engineering, Inc (cmd@maritechengineering.com); Anthony Néron, representing DuChanvre (info@duchanvre.com); Marilynn Hill, representing Self (knowledgeisliving@yahoo.com); Laurent Goudet, representing Expert hemp concrete builder; Sergiy Kovalenkov, Hempire International, representing Hempire International (sergiy@hempire.tech); Dion Lefebvre, representing Divita Hemp Block (8thfireinnovations@gmail.com)

2021 International Residential Code

Add new text as follows:

SECTION AY101
GENERAL

AY101.1 Scope. This appendix shall govern the use of hemp-lime as a nonbearing building material, and wall infill system in Seismic Design Categories A, B, and C, and in Seismic Design Categories D_0, D_1, and D_2 with an *approved* engineered design by a *registered design professional* in accordance with Section R301.1.3.

SECTION AY102
DEFINITIONS

AY102.1 General. The following words and terms shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 for general definitions.

BINDER. The material that binds the hemp hurd in a hemp-lime mix.

BONDING COAT. The initial thin layer of binder-rich granulated plaster used in lined applications of hemp-lime construction to ensure adhesive and/or mechanical bonding. Also known as gobetis.

CAST-IN-PLACE. Installation of hemp-lime mix by hand or by spraying into forms in its permanent location.

CASTING. Placing wet hemp-lime into forms.

CLAY. Inorganic soil with particle sizes less than 0.00008 inch (0.002 mm) and having the characteristics of high dry strength and medium to high plasticity, used as a binder of other component materials in clay plaster.

CLAY SUBSOIL. Subsoil sourced directly from the earth, containing clay, sand and silt, and containing not more than trace amounts of organic matter.

FIBER CLUMPS. Long fibers that are attached to hemp hurd, or for other reasons, cause clumping of fibrous balls when agitated.

FINISH. Exposed surface material on the interior or exterior face of a hemp-lime infill wall.

FORM. The material into which hemp-lime infill, panels, or blocks are cast.

FORMWORK. The system of forms, their bracing and fasteners assembled for casting of hemp-lime infill.

HAND CAST. Hemp-lime infill cast by placing hemp-lime mix into formwork and evenly tamping by hand or with a tool.

HEMP. A class of the Cannabis sativa plant grown for industrial purposes in which the concentration of total delta-9 tetrahydrocannabinol (THC) in the flowering tops is equal to or less than the regulated maximum level established by authorities having jurisdiction.

HEMPCRETE. Common usage term for hemp-lime.

HEMP-LIME. A bio-aggregate composite consisting of hemp hurd and a lime-based binder. Also known as hempcrete.

HEMP HURD. The chopped woody core of the stalks of the hemp plant, stripped of its surrounding hemp fibers. Also known as hemp shiv or shive.

INFILL. Hemp-lime placed between or around the structural or nonstructural framing of a building as insulation, thermal mass, and a substrate for finish.

LIFT. A horizontal layer of hemp-lime infill.

LIME. Lime is composed of calcium hydroxide ($Ca(OH)_2$) including Type N or S hydrated lime, hydraulic lime, natural hydraulic lime or slaked quicklime.

LINED APPLICATION. Installation of a vertical hemp-lime layer, lining a masonry or concrete wall.

NATURAL CEMENT. Hydraulic cement made from naturally occurring limestone.

NONBEARING. Not bearing the weight of the building other than the weight of the hemp-lime infill and its finish.

PLASTER. Lime, clay, clay-lime, or hemp-lime plaster as described in Section AY104.3, applied to the interior or exterior face of hemp-lime walls.

POZZOLAN. A siliceous or alumino-siliceous material that when finely divided and combined with hydrated lime in the presence of water forms new chemical compounds with cementitious properties.

PRECAST. Blocks or panels of hemp-lime formed and cured before installation.

SCREEDING. Removal of excess material to form a planar surface.

REED MAT. A mat consisting of reed, cane, bamboo, or other similar plant material.

SPRAY-APPLIED. A method of mechanical projection of hemp-lime applied onto or into a form using compressed air.

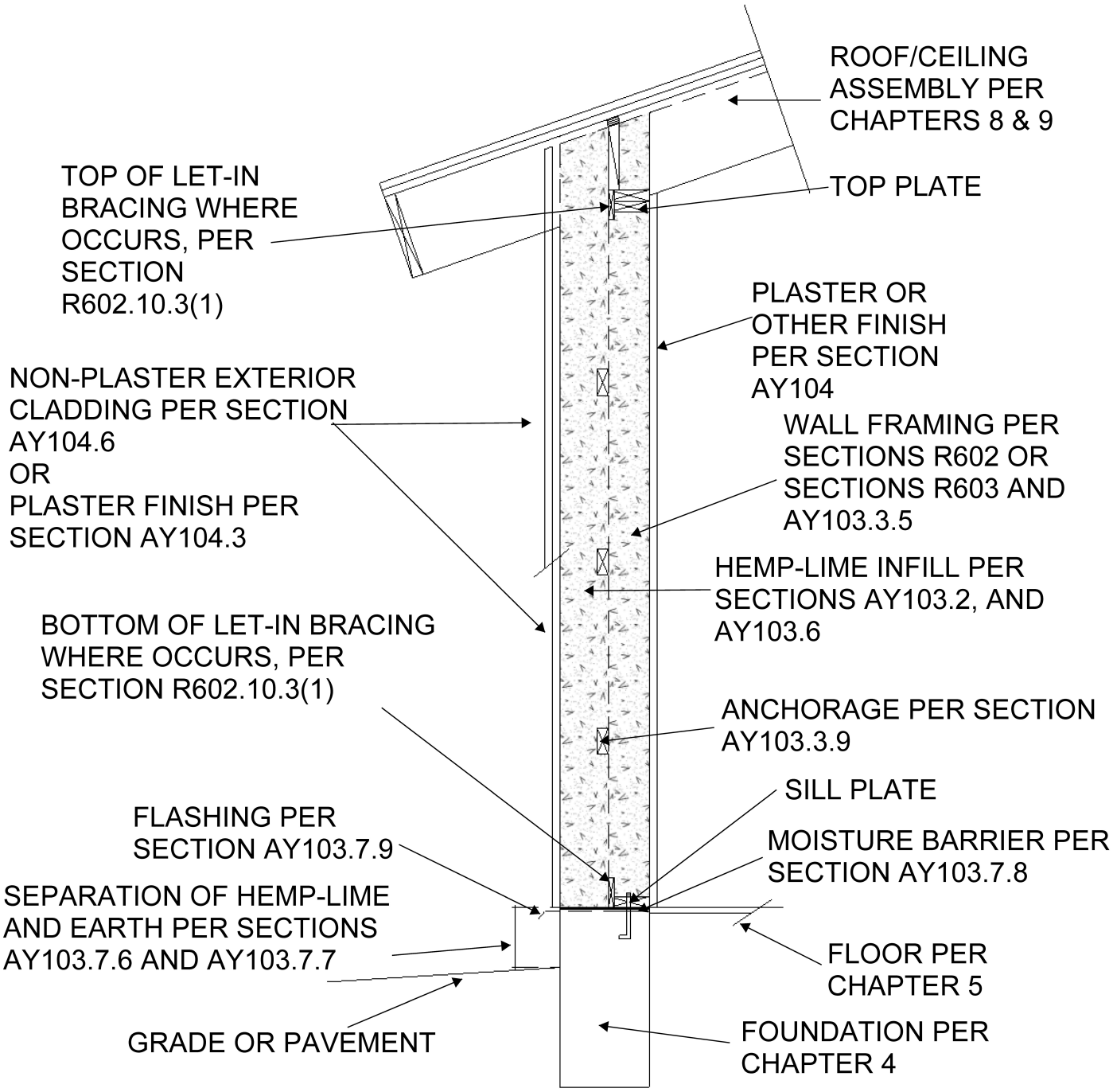
TADELAKT. A lime-plaster which is compressed, polished, and treated with oil-based soap to make it water-repellant.

UNIT WALL WEIGHT. The unit wall weight is the calculated weight of a 1 foot by 1 foot (305 mm by 305 mm) section of wall surface area times the full wall thickness, including finishes. The unit wall weight is the sum of the weight of each constituent material times its volume, expressed as psf.

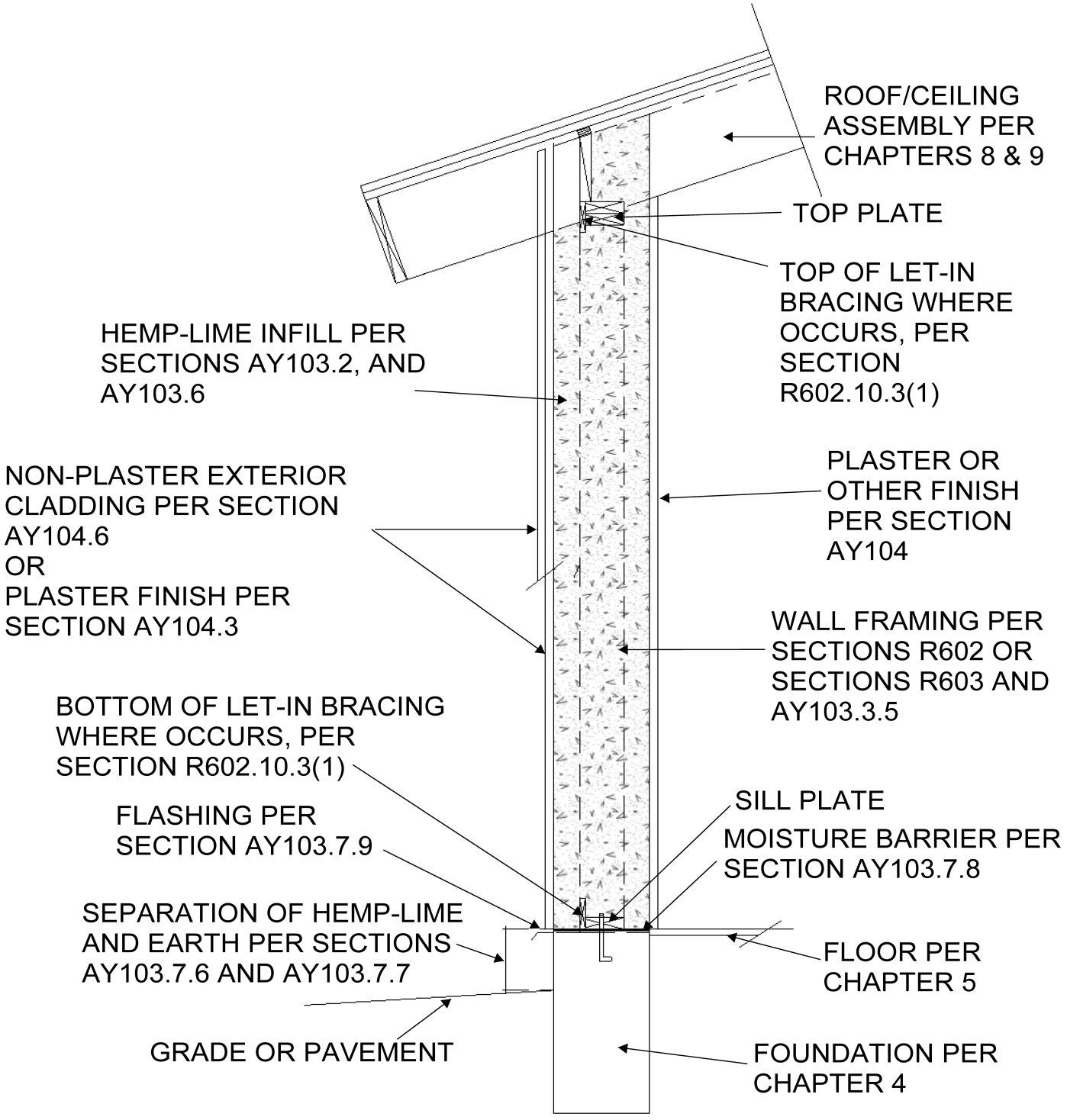
VOID. Any space in a hemp-lime wall greater than ¼ inch (6 mm) wide, 2 inches (51mm) long and 2 inches (51 mm) deep.

SECTION AY103
HEMP-LIME CONSTRUCTION

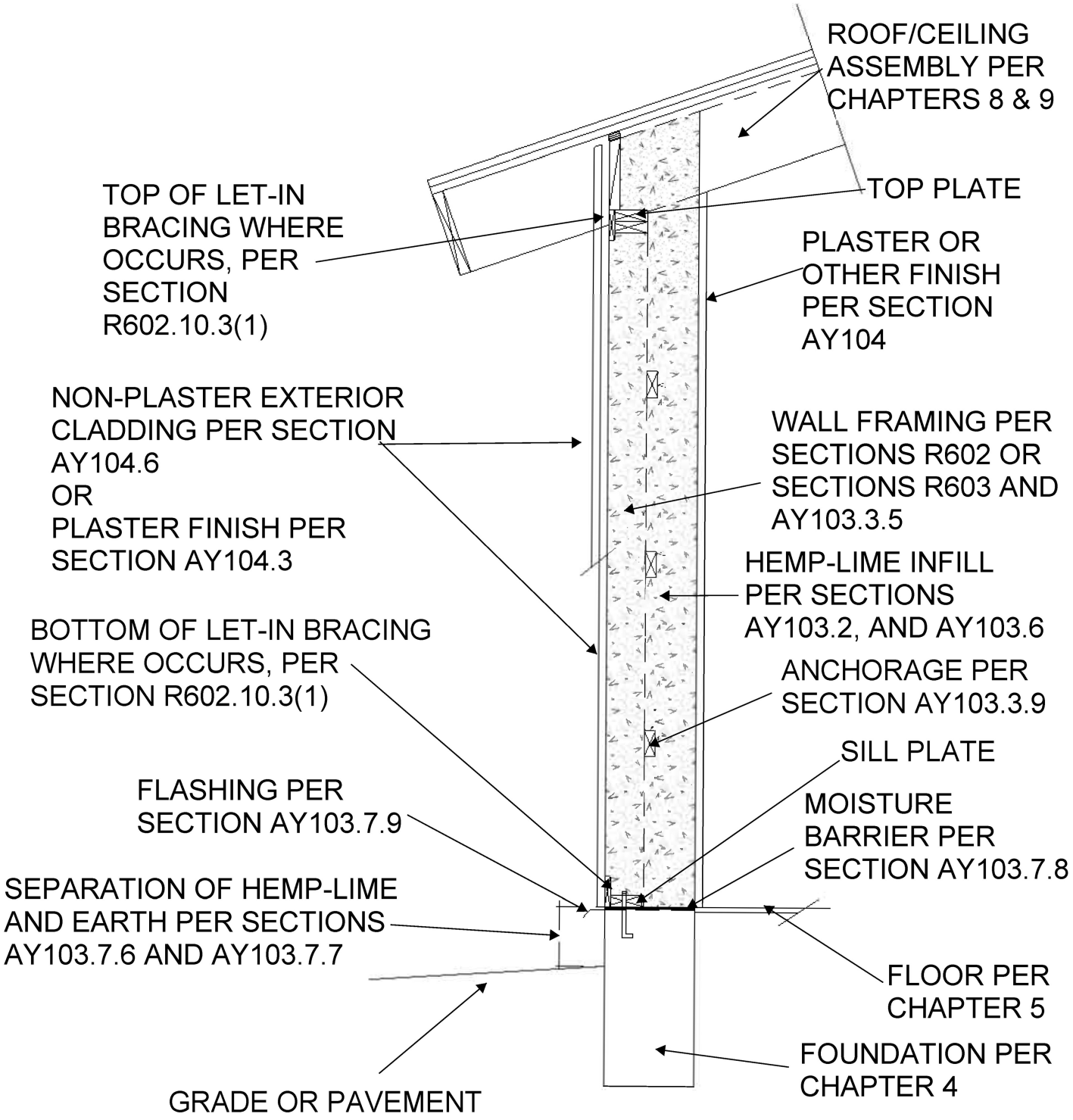
AY103.1 General. Hemp-lime construction shall be limited to the non-structural, solid *infill* mix of *hemp hurd* and its *binder* between or around structural and non-structural wall framing. Hemp-lime *infill* shall have a density ranging from 12.5 lb/ft^3 to 25 lb/ft^3 (200 kg/m^3 to 400 kg/m^3). Hemp-lime walls shall be designed and constructed in accordance with Section AY103 and with Figures AY103.1(1) through AY103.1(4) or an *approved* alternative design.



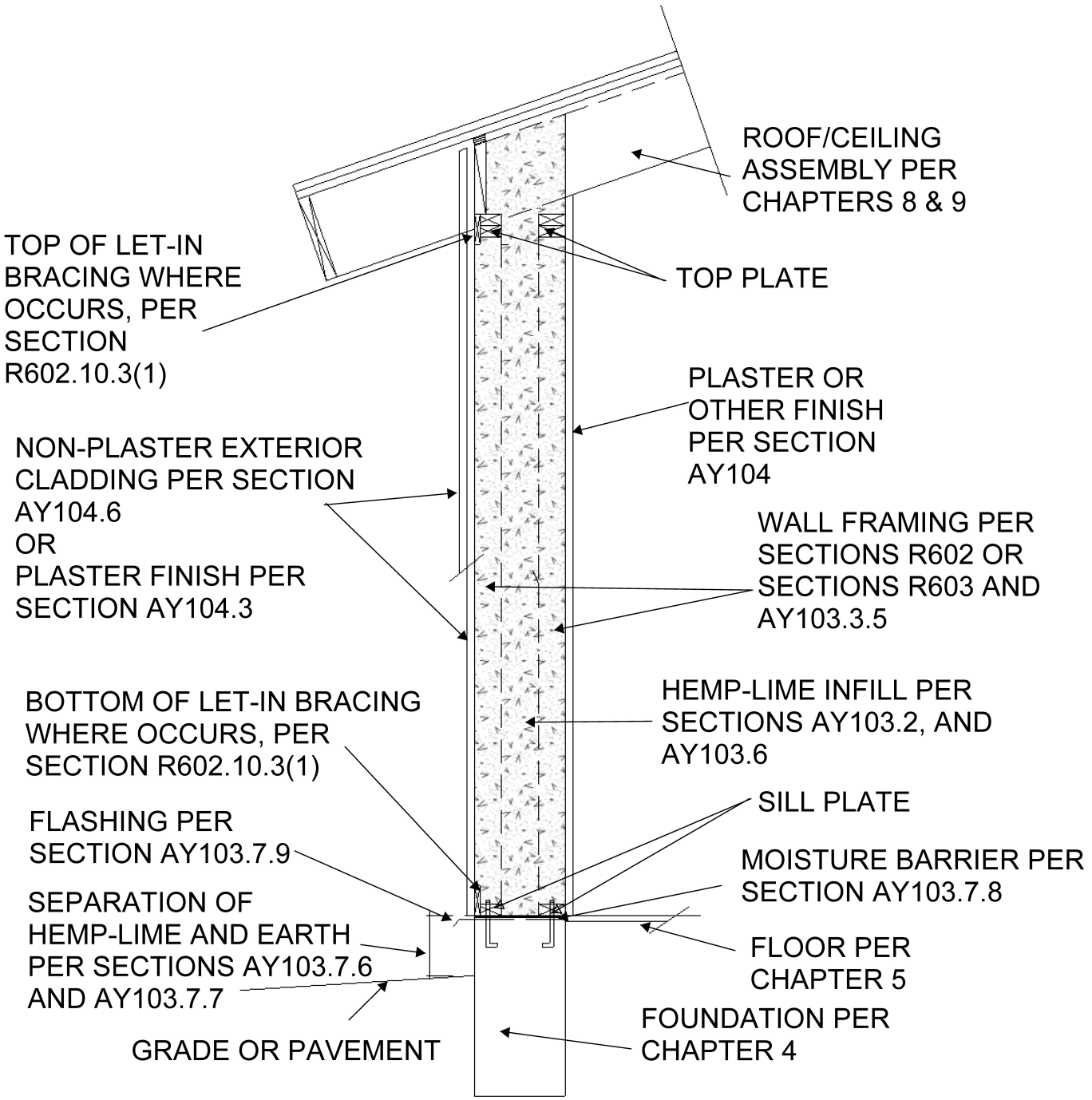
AY103.1(1) TYPICAL HEMP-LIME WITH INTERIOR STUD FRAMING



AY103.1(2) TYPICAL HEMP-LIME WITH CENTER STUD FRAMING



AY103.1(3) TYPICAL HEMP-LIME WITH EXTERIOR STUD FRAMING



AY103.1(4) TYPICAL HEMP-LIME WITH DOUBLE STUD WALL FRAMING

AY103.2 Materials. Materials to be used in hemp-lime construction shall be in accordance with Sections AY103.2 through AY103.2.3.

AY103.2.1 Hemp hurd. *Hemp hurd* shall match the specifications of the *approved* test samples in Sections AY106.3 and AY107.1. *Hemp hurd* shall be substantially free from dust and *fiber clumps* such that the installed hemp-lime maintains its integrity.

AY103.2.2 Binders. Acceptable *binders*, singular or in combination, include hydraulic *lime*, hydrated *lime*, *pozzolans*, *natural cements*, or other *binders* that match the specification of the *approved* test samples in Sections AY106.3 and AY107.1.

AY103.2.3 Water and water additives. Water and any water additives shall match the specifications of the *approved* test samples in Sections AY106.3 and AY107.1.

AY103.3 Structure. The structure of buildings using hemp-lime *infill* shall be in accordance with the IRC and Sections AY103.3.1 through AY103.3.9 or with an *approved* engineered design by a *registered design professional.*

AY103.3.1 Limitations and requirements for buildings using hemp-lime infill. *Buildings* using hemp-lime *infill* shall be subject to the following

limitations and requirements:

1. Number of stories: not more than one *story above grade plane.*
2. The building height shall not be more than 25 feet (7620 mm).
3. Braced wall panel lengths: in accordance with Section R602.10.3 and Section AY103.3.2.
4. Unit wall height: Hemp-lime walls shall not exceed an average *unit wall weight* of 65 pounds per square foot (217 kg/m^2).

AY103.3.2 Bracing. Bracing for buildings with hemp-lime *infill* in Seismic Design Categories A, B, and C shall be in accordance with Section R602.10 and in accordance with the following. Walls with hemp-lime *infill* shall use Method LIB and shall not be braced with solid sheathing. Hemp-lime *infill* walls utilizing Method LIB shall not require gypsum board to be installed and the minimum braced wall lengths listed in Section R602.10. Adjustment factors in Table R602.10.3(4) shall be used as applicable. Alternatively, hemp-lime *infill* walls shall comply with Section R301.1. Walls or wall sections without hemp-lime *infill* shall be permitted to use any bracing method allowed in Section R602.10.

AY103.3.3 Connection of light-frame walls to hemp-lime walls. Light-frame walls perpendicular to, or at an angle to a hemp-lime wall assembly, shall be fastened to the hemp-lime wall in accordance with Section R602 or R603.

AY103.3.4 Hemp-lime thickness. Hemp-lime *infill* shall be not less than 3 inches (76 mm) thick between face of framing and finish. Maximum hemp-lime wall thickness is limited by the average *unit wall weight* limit of 65 pounds per square foot (317 kg/m^2) in Section AY103.3.1, Item 4.

AY103.3.5 Contact with structural metal. Structural metal members and components in contact with hemp-lime shall be protected in accordance with Section AY103.4.

AY103.3.6 Contact with wood members. Hemp-lime shall be permitted to be in contact with untreated wood members.

AY103.3.7 Openings in walls. Door, window, and similar openings in hemp-lime walls shall be in accordance with the following:

1. Rough framing for doors and windows shall be part of, or be fastened to the wall framing in accordance with the IRC.
2. An *approved water-resistive barrier* shall be installed at openings in hemp-lime walls in accordance with Sections AY103.7.4 and AY104.5.1.
3. Header size and their maximum span above openings in bearing walls with hemp-lime *infill* shall be determined with Table R602.7(1) and Table AY103.3.7 or a design approved by a registered design professional
4. *Cast-in-place* hemp-lime over and overhanging the face of a header more than 3 inches (76 mm) shall require an *approved* design of its support by a *registered design professional.*
5. Hemp-lime blocks overhanging headers shall require an *approved* design of their support by a *registered design professional.*

TABLE AY103.3.7 ALLOWABLE HEADER SPAN MULTIPLIER[a]

WALL HEIGHT ABOVE HEADER	UNIT WALL WEIGHT (psf)			
	15	30	45	65
1'-0"	1.00	1.00	1.00	1.00
1'-6"	1.00	1.00	0.90	0.90
2'-0"	1.00	0.90	0.90	0.85
2'-6"	1.00	0.90	0.90	0.85
3'-0"	1.00	0.90	0.90	0.80

a. Multiply the maximum allowable spans from Table R602.7(1) by the applicable factor to determine the adjusted maximum allowable header span.

AY103.3.8 Voids. *Voids* shall be filled with hemp-lime or other *approved* material before application of finish.

AY103.3.9 Anchorage of hemp-lime. Hemp-lime for interior and exterior stud walls shall be anchored, or shall be in accordance with an *approved* design by a *registered design professional.* Horizontal anchorage rails shall be installed at not more than 24 inches (610 mm) on center and in accordance with Figure AY103.1(1) and AY103.1(3). Horizontal anchorage rails shall be no less than 1 inch by 2 inch (25 mm by 51 mm). Anchorage rails shall be wood, metal per Section AY103.4, or other *approved* material. Anchorage rails should be attached to the side of the stud facing the interior of the wall with (1) - 8d box nail to each stud and run the entire length of the wall.

AY103.4 Contact with metal. Metal in contact with hemp-lime shall be stainless steel or primed and painted with a coating in accordance with Section AY103.4.1.

AY103.4.1 Protective coatings. Metal shall be painted with an epoxy, oil, bituminous paint or other *approved* coating. Water based paints shall not be used.

Exception: Heads of pneumatically driven hot-dip galvanized nails.

AY103.5 Mechanical, electrical and plumbing in hemp-lime infill. Electrical and telecommunication wiring, panels, and boxes, mechanical ducts, plumbing pipes, and other mechanical, electrical and plumbing components in or in contact with hemp-lime *infill* shall be isolated in sleeves, pipes, conduits, or tubing made of plastic, or of metal in accordance with Section AY103.4, or separated from hemp-lime with an *approved* alkaline-resistant material.

AY103.6 Hemp-lime installation methods. Hemp-lime shall be installed in accordance with Sections AY103.6.1 and AY103.6.2, and one of Sections AY103.6.3 through AY103.6.7.

AY103.6.1 Mix and mixing. The materials and ratio of *hemp hurd* to *binder* to water shall match the specifications of the *approved* test samples in Sections AY106.3 and AY107.1. The water to *binder* ratio shall be not less than 1:1 and not greater than 2:1 by weight or by *binder* manufacturer's recommendations. The *hemp hurd*, *binder*, and water shall be thoroughly and uniformly mixed by manual or mechanical means.

AY103.6.2 Formwork for hand cast and spray-applied methods. *Forms* shall be removable or permanent and shall not deform under the lateral pressure of the installed wet hemp-lime.

AY103.6.2.1 Permanent forms. Permanent *forms* shall be permitted to be installed on only one side. Permanent *forms* shall be *reed mats*, or other *approved* materials with an open weave. Sheet materials shall not be used as permanent *forms*. Permanent *forms* remain after curing as a finish or substrate for another finish.

Exception: Permanent *forms* of any material shall be permitted at the jambs, heads, and sills of openings.

AY103.6.2.2 Removable forms. Removable *forms* shall be removed within 24 hours after hemp-lime placement or per the *binder* manufacturer's specifications.

Exception: Removable *forms* temporarily supporting hemp-lime *infill* above wall openings shall not be removed for a minimum of 3 days or per *binder* manufacturer's specifications.

AY103.6.3 Hand cast. Hand cast hemp-lime *infill* shall be installed in uniform *lifts* not greater than 4 inches (102 mm) in height. Each *lift* shall be tamped to achieve stable walls free of *voids*.

AY103.6.4 Spray-applied. *Spray-applied* hemp-lime *infill* shall be installed in accordance with Sections AY103.6.4.1 through AY103.6.4.4.

AY103.6.4.1 Forms. *Forms* shall be installed on one side in accordance with Section AY103.6.2 or AY103.6.7.2 for *lined applications*.

AY103.6.4.2 Mixing. Mixing shall be in accordance with Sections AY103.6.1 or the spray equipment manufacturer's instructions.

AY103.6.4.3 Installation. Hemp-lime shall be sprayed from the base up and per the spray equipment manufacturer's and/or *binder* manufacturer's instructions.

AY103.6.4.4 Screeding. Excess hemp-lime shall be removed by *screeding* per the spray equipment manufacturer's and/or *binder* manufacturer's instructions.

AY103.6.5 Precast blocks. *Precast* hemp-lime blocks shall be cast and installed in accordance with Sections AY103.6.5.1 through AY103.6.5.5 or per manufacturer's specifications:

AY103.6.5.1 Block dimensions. Hemp-lime blocks shall be a minimum thickness of 3 inches (76 mm) in all dimensions and shall not exceed the maximum thickness in accordance with Section AY103.3.4.

AY103.6.5.2 Casting. Hemp-lime blocks shall be cast in accordance with Sections AY103.6.1 through AY103.6.6 as applicable, or by other means that produce *approved* blocks.

AY103.6.5.3 Mortar. Mortar shall consist of *lime* and sand or other aggregate with a ratio of not less than 1:1 and not greater than 1:3, or other *approved* mortar. The *lime* shall be hydrated Type N or S, or hydraulic *lime*.

AY103.6.5.4 Installation. Hemp-lime blocks shall be installed in a running bond between and around wall framing members. Mortar shall fill all voids between blocks and shall not be not less than ⅛ inch (3 mm) thick. Spaces between blocks and framing shall be not more than ¾ inch (19 mm) and shall be filled with mortar.

AY103.6.5.5 Hemp-lime block veneer. Hemp-lime block veneer shall not exceed 50 pounds per square foot (244 kg/m^2) of veneer only *unit wall weight*, shall be limited to 5-inch (127 mm) thickness, and shall be anchored to the supporting wall studs in accordance with Section R703.8.4 or secured with *approved* ties and fasteners to an *approved* backing. Metal ties and fasteners shall be protected in accordance with Section AY103.4.

AY103.6.6 Hemp-lime panels. Hemp-lime panels shall require an *approved* design by a *registered design professional*.

AY103.6.7 Lined application. Interior and exterior hemp-lime *lined applications* shall be installed in accordance with Section AY103.6.7.1 through AY103.6.7.6 and Sections AY103.6.3 through AY103.6.6 as applicable.

AY103.6.7.1 General. Prior to installation, the concrete or masonry walls receiving the installation shall be clean, and free of loose mortar. Lined installations on basement walls shall require an *approved* design by a *registered design professional*. Exterior applications shall be in accordance with Section AY103.7.6. Attachment of *precast* blocks to the receiving wall shall be in accordance with Section AY103.6.5.5. Attachment of hemp-lime panels to the receiving wall shall be in accordance with Section AY103.6.6.

AY103.6.7.2 Formwork. *Forms* shall be in accordance with Section AY103.6.2. Permanent *formwork* shall not be allowed on the non-receiving wall side.

AY103.6.7.3 Thin lining. Thin linings are from 3 to 4¾ inches (76 to 121 mm) thick. Hand troweled hemp-lime shall be installed over a *bonding coat*.

AY103.6.7.4 Medium lining. Medium linings exceed 4¾ inches (121 mm) and are not greater than 6½ inches (165 mm) thick. For *hand cast* or *spray-applied*, 1½ inch (38 mm) X 1½ inch (38 mm) dovetail shaped vertical anchorage rails shall be attached with the narrowest face to the receiving wall, spaced not less than 20 inches (508 mm) and not greater than 32 inches (813 mm), with fasteners not less than 2 feet (610 mm) and not greater than 3 feet (914 mm) apart. *Hand cast* medium linings shall be installed over a *bonding coat* on the receiving wall. See Figure AY103.6.7.4.

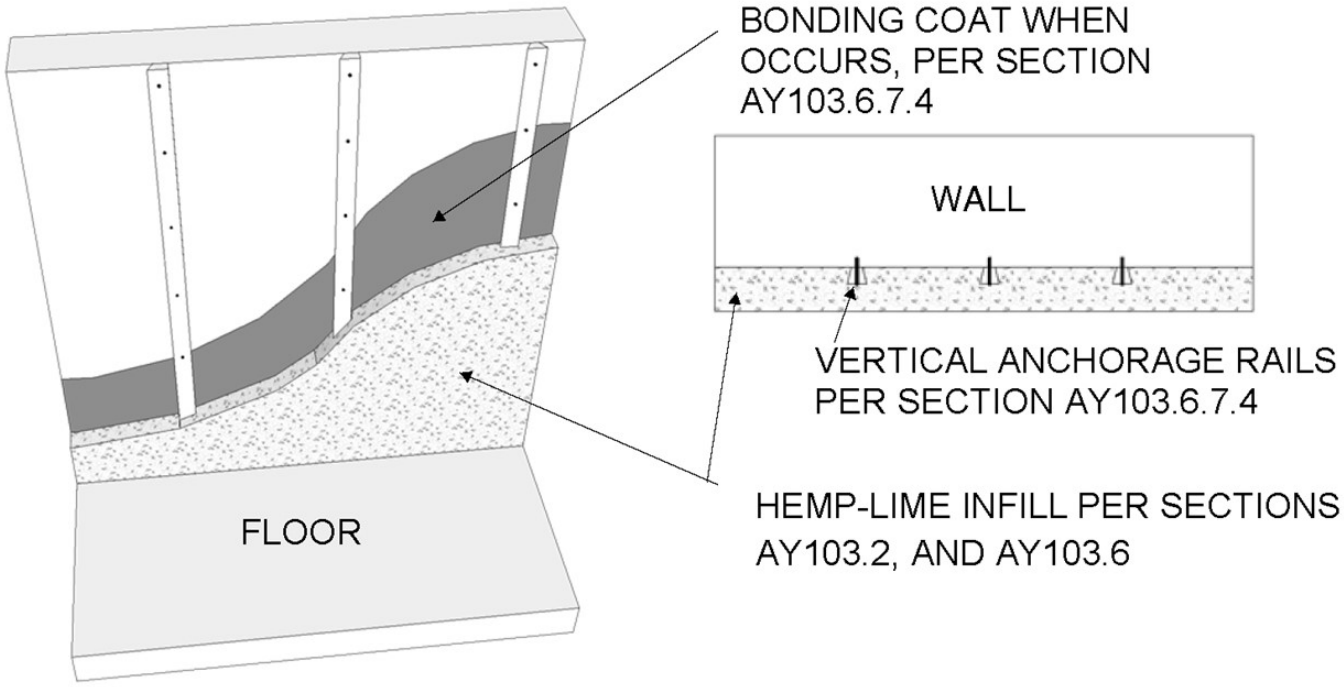


FIGURE AY103.6.7.4 TYPICAL HEMP-LIME MEDIUM LINING

AY103.6.7.5 Thick lining. Thick linings exceed 6½ inches (165 mm) and shall not be greater than 8 inches (203 mm) thick or per the binder manufacturer's specifications. For *hand cast* or *spray-applied*, 1½ inch (38 mm) x 2½ inch (64 mm) vertical anchorage rails shall be attached with the 2½ inch (64 mm) face parallel to the receiving wall and spaced not less than 20 inches (508 mm) and not greater than 32 inches (813 mm). The anchorage rails shall be fastened to and separated from the receiving wall with 2 inch (51 mm) spacers not less than 3 feet (914 mm) and not greater than 4 feet (1,219 mm) apart. *Hand cast* thick linings shall be installed over a *bonding coat* on the receiving wall. See Figure AY103.6.7.5.

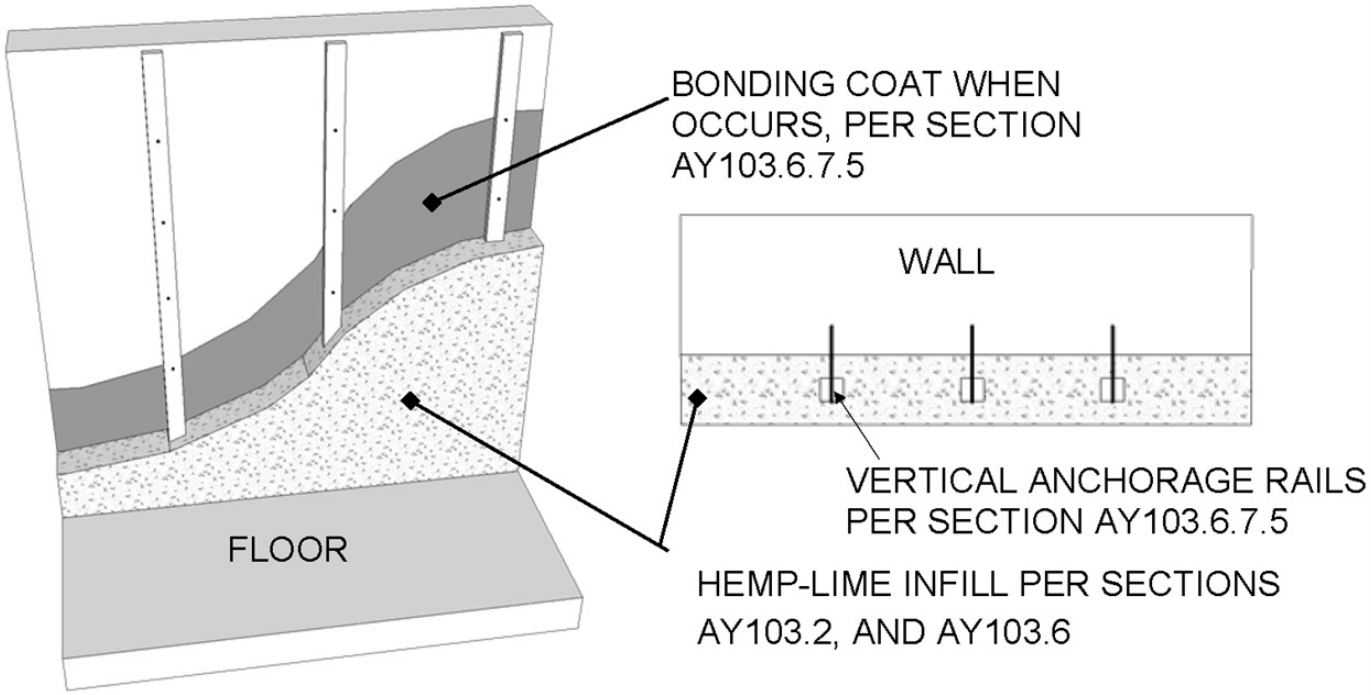


FIGURE AY103.6.7.5 TYPICAL HEMP-LIME THICK LINING

AY103.6.7.6 Minimum thickness at anchorage rails. The minimum thickness of hemp-lime between the exterior face of vertical anchorage rails and finished face of hemp-lime shall be 3 inches (76 mm) or in accordance with the *binder* manufacturer's specifications.

AY103.7 Moisture Control. Hemp-lime assemblies shall be protected from water intrusion and damage in accordance with Section AY103.7.1 through AY103.7.9.

AY103.7.1 Water-resistive barriers. *Water-resistive barriers* are prohibited on hemp-lime walls, except as permitted or required elsewhere in this appendix.

AY103.7.2 Vapor retarders. Vapor retarders are prohibited on hemp-lime walls, except as permitted or required elsewhere in this appendix.

AY103.7.3 Penetrations in hemp-lime walls. Penetrations in exterior hemp-lime walls shall be sealed with an *approved* sealant or gasket on the exterior side of the wall in all climate zones, and on the interior side of the wall in Climate Zones 5, 6, 7, 8 and Marine 4, as defined in Chapter 11.

AY103.7.4 Horizontal surfaces. Hemp-lime walls and other hemp-lime assemblies shall be provided with a *water-resistive barrier* at weather-exposed horizontal surfaces. The *water-resistive barrier* shall be of a material and installation that will prevent water from entering the wall system. Horizontal surfaces shall include exterior window sills, and sills at exterior niches. Horizontal surfaces shall be sloped not less than 1 unit vertical in 12 units horizontal (8-percent slope) and shall drain away from hemp-lime walls and other assemblies. Where the *water-resistive barrier* is below the finish material, it shall be sloped not less than 1 unit vertical in 12 units horizontal (8-percent slope) and shall drain to the exterior surface of the hemp-lime wall's vertical finish.

AY103.7.5 Air barrier. Exterior hemp-lime walls shall have a *vapor permeable air barrier* on all exterior and interior surfaces, except as permitted or required elsewhere in this appendix. Plaster in accordance with Section AY104.3 shall be acceptable as an *air barrier*.

AY103.7.6 Separation of hemp-lime and earth or paved areas. Hemp-lime shall be not less than 8 inches (203 mm) above exposed earth or paved areas.

AY103.7.7 Separation of exterior plaster and earth or paved areas. Exterior *plaster* applied to hemp-lime shall be not less than 8 inches (203 mm) above exposed earth or paved areas.

AY103.7.8 Separation of hemp-lime and exterior plaster from foundation. Hemp-lime and exterior *plaster* shall be separated from the foundation with an *approved* moisture barrier.

AY103.7.9 Base of wall flashing. Outer face of exterior walls shall be flashed to prevent water intrusion at the base of the wall.

SECTION AY104
FINISHES

AY104.1 General. The interior and exterior surfaces of hemp-lime walls shall be protected with a finish in accordance with Section AY104. Finishes shall have a vapor permeance rating of 5 perms or greater tested in accordance with Procedure B of ASTM E96.

AY104.2 Moisture content prior to application of finish. Hemp-lime *infill* shall have an average moisture content of no more than 20 percent at a depth of 1½ inches (38 mm), as measured from the face of the wall to which the finish will be applied for each wall. Moisture content shall be measured with a probe style wood moisture equivalent (WME) meter.

AY104.3 Plaster Finish. Exterior *plaster* shall be *lime plaster*, *clay plaster* in accordance with Section AY104.3.6.3, or other *approved plaster*. Interior *plasters* shall be any *plaster* permitted in Sections AY104.3.1 through AY104.3.9. *Plasters* shall be permitted to be applied directly to the surface of the hemp-lime *infill* without reinforcement, except that the juncture of dissimilar substrates shall be in accordance with Section AY104.5. *Plasters* shall have a thickness of not less than ½ inch (13 mm) on the interior and ¾ inch (19 mm) on the exterior, and shall be installed in not less than two coats, or per binder manufacturer's instructions. Not less than ⅜ inch (10 mm) exterior *plaster* is permitted behind exterior cladding in accordance with Section AY104.6.

AY104.3.1 Membranes. Membranes are prohibited between *plaster* and hemp-lime except where a membrane is allowed or required elsewhere in this appendix.

AY104.3.2 Lath and mesh for plaster. The surface of the hemp-lime functions as lath, and other lath or mesh shall not be required, except as required in Section AY104.5.

AY104.3.3 Plaster additives. Additives shall be permitted to increase *plaster* workability, durability, strength or water resistance. Additives shall not reduce the *plaster* vapor permeance rating to less than 5 perms. Additives containing polymers are prohibited.

AY104.3.4 Plaster reinforcing fibers. Reinforcing fibers shall be permitted in plaster. Acceptable reinforcing fibers include hemp fiber, chopped straw, sisal, animal hair and fiberglass.

AY104.3.5 Lime plaster. *Lime* plaster is any plaster with a *binder* primarily composed of calcium hydroxide ($Ca(OH)_2$) including Type N or S hydrated *lime*, hydraulic *lime*, natural hydraulic *lime* or slaked quicklime. Hydrated *lime* shall comply with ASTM C206. Hydraulic *lime* shall comply with ASTM C1707. Natural hydraulic *lime* shall comply with ASTM C141 and CEN EN 459. Quicklime shall comply with ASTM C5. *Lime* plaster shall contain sufficient *lime* to fully bind the sand or other aggregate, and shall be permitted to contain pozzolans.

AY104.3.6 Clay plaster. *Clay* plaster shall be any plaster having a *clay* or *clay subsoil binder*. Such plaster shall contain sufficient *clay* to fully bind the sand or other aggregate.

AY104.3.6.1 Clay subsoil requirements. The suitability of *clay subsoil* shall be determined in accordance with the Figure 2 Ribbon Test and the Figure 3 Ball Test in the appendix of ASTM E2392/E2392M.

AY104.3.6.2 Thickness and coats. *Clay* plaster shall be not less than ¾ inch (19 mm) thick, and shall be applied in not less than two coats.

AY104.3.6.3 Rain-exposed. *Clay* plaster, where exposed to rain, shall be finished with an *approved* erosion-resistant finish.

AY104.3.6.4 Prohibited finish coat. Plaster containing Portland cement shall not be permitted as a finish coat over *clay* plasters.

AY104.3.7 Clay-lime plaster. Clay-lime plaster shall be composed of refined *clay* or *clay subsoil*, sand, and *lime*.

AY104.3.8 Hemp-lime plaster. Hemp-lime plaster shall be composed of *hemp hurd* and *lime*, and shall be permitted to contain sand or other aggregate, and *pozzolans*.

AY104.3.9 Hemp-clay plaster. Hemp-clay plaster shall be composed of *hemp hurd* and *clay* or *clay subsoil*, and shall be permitted to contain sand or other aggregate.

AY104.4 Separation of wood and plaster. Wood framing at the exterior surface of hemp-lime walls shall be separated from exterior plaster with Grade D paper or other approved material, except where the wood is naturally durable.

Exception: Exterior *clay* plaster shall not be required to be separated from wood.

AY104.5 Bridging across dissimilar substrates. Bridging shall be installed onto and across dissimilar substrates prior to the application of plaster on the interior or exterior. Acceptable bridging materials include expanded metal lath, woven wire mesh, welded wire mesh, fiberglass mesh, *reed mat*, burlap, or other *approved* material. Bridging shall extend not less than 3 inches (76 mm), on both sides of the juncture.

AY104.5.1 Returns on recessed openings. Plaster or other exterior finish returns at recessed windows and doors shall require an *approved* design that prevents the intrusion of moisture.

AY104.6 Non-plaster exterior cladding. Non-plaster exterior *cladding* shall be spaced not less than 1 inch (25 mm) from the face of the *water-resistive barrier* or *air barrier* to the back of the cladding to allow for ventilation. The ventilation space shall be open at the top and bottom and be provided with insect screening.

AY104.6.1 Water-resistive and air barriers. *Water-resistive barriers* and *air barriers*, when *vapor permeable*, are permitted to be applied directly to the hemp-lime when exterior *cladding* is installed in accordance with Section AY104.6.

AY104.7 High moisture interior environments. Exterior hemp-lime walls enclosing showers or steam rooms shall be lined on the interior side with ceramic tiles on an *approved* tile backer board, ceramic tiles on a *lime* plaster, or a *tadelakt* finish.

SECTION AY105
FIRE RESISTANCE

AY105.1 Fire-resistance rating. Hemp-lime walls do not have a fire-resistance rating. Fire-resistance ratings for hemp-lime wall assemblies shall be determined in accordance with the required testing in Section R302.9.3.

AY105.2 Clearance to fireplaces and chimneys. Hemp-lime surfaces adjacent to fireplaces or chimneys shall be finished with not less than ⅜ inch (10 mm) thick plaster of any type permitted by this appendix. Clearance from the face of such plaster to fireplaces and chimneys shall be maintained as required from fireplaces and chimneys to combustibles in Chapter 10, or as required by manufacturer's instructions, whichever is more restrictive.

SECTION AY106
THERMAL PERFORMANCE

AY106.1 Mass Walls. Walls with hemp-lime infill shall be classified as mass walls in accordance with Section N1102.2.5 (R402.2.5) and shall meet the R-value requirements for mass walls in Table N1102.1.3 (R402.1.2), when their heat capacity (C) is greater than or equal to 6 Btu/ft^2× °F (123 kJ/m^2× K) in Equation AY-1.

$C = \rho \times t \times 0.299$ Btu/lb× °F **(Equation AY-1)**

where:

C = Heat capacity (Btu/ft^2× °F).

ρ = Density of hemp-lime infill (pounds per cubic foot).

t = Thickness of hemp-lime infill (in feet).

AY106.2 Thermal resistance. Hemp-lime has the unit thermal resistance values in accordance with Table AY106.2. Alternatively, the unit R-value of hemp-lime shall be determined with one of the following tests by an approved laboratory: ASTM C518, ASTM C1363, ASTM C177, or ASTM C1114. Test results from a specific hemp-lime mix shall be permitted to be used for multiple projects.

Table AY106.2 Thermal Resistance of Hemp-Lime[a]

Density (pounds per cu.ft.)	R-value ($ft^2 \cdot °F \cdot h/BTU$ per inch of thickness)
12.5	R-2.10
15	R-1.86
20	R-1.54
25	R-1.20

a. Linear interpolation is permitted. Extrapolation is not permitted.

AY106.3 Density measurement. Hemp-lime density shall be measured based on *approved* test samples as follows:

1. Three samples of the proposed hemp-lime mix shall be placed moist to completely fill a 6-inch by 6-inch by 12-inch (152 mm by 152 mm by 305 mm) form, a 6 inch (152mm) diameter x 12 inch (305 mm) length form or other *approved* form, following the application method and procedure that will be used during construction.
2. Samples shall be removed from the forms within 24 hours after hemp-lime placement or per the *binder* manufacturer's specifications.
3. Samples shall be cured/dried for a minimum of 14 days in indoor ambient conditions before density determination.
4. Density shall be determined by Equation AY-2.

$\rho = w / V$ **(Equation AY-2)**

where:

ρ = Density of hemp-lime infill (pounds per cubic foot).

w = Weight of hemp-lime infill sample (pounds).

V = Volume of hemp-lime sample (in cubic feet).

AY106.4 Compliance with Section R302.10.1. Hemp-lime *infill* meet the requirements for insulation materials in Section R302.10.1 for flame spread index and smoke-developed index as tested in accordance with ASTM E84.

SECTION AY107
MECHANICAL PERFORMANCE

AY107.1 Hemp-lime infill integrity. The integrity of hemp-lime *infill* and its ability to hold a plaster finish shall be demonstrated with a minimum compressive strength of 29 psi (0.2 MPa). Test results from a specific hemp-lime mix shall be permitted to be used for multiple projects.

AY107.1.1 Demonstration of compressive strength. The compressive strength of the hemp-lime mix shall be demonstrated to the building official before the placement of hemp-lime infill, with compressive strength tests and an associated report by an *approved* laboratory tested as follows:

1. Three samples of the proposed hemp-lime mix shall be placed moist to completely fill a 6-inch by 6-inch by 12-inch (152 mm by 152 mm by 305 mm) form, a 6 inch (152mm) diameter x 12 inch (305 mm) length form, or other *approved* form, following the application method and procedure that will be used during construction.
2. Samples shall be removed from the forms within 24 hours after hemp-lime placement or per the *binder* manufacturer's specifications.
3. Samples shall be cured/dried for a minimum of 14 days in indoor ambient conditions before testing.
4. The opposite faces shall be capped with plaster of paris to achieve smooth and parallel faces, after which the sample shall reach ambient moisture conditions before testing.
5. The horizontal cross section of the dried sample as tested, and the maximum applied load at failure shall be used to calculate the sample's compressive strength.
6. The average value of the samples shall be used to determine the mix's compressive strength.

SECTION AY108
REFERENCED STANDARDS

AY108.1 General. See Table AY108.1 for standards that are referenced in various sections of this appendix. Standards are listed by the standard identification with the effective date, the standard title, and the section or sections of this appendix that reference this standard.

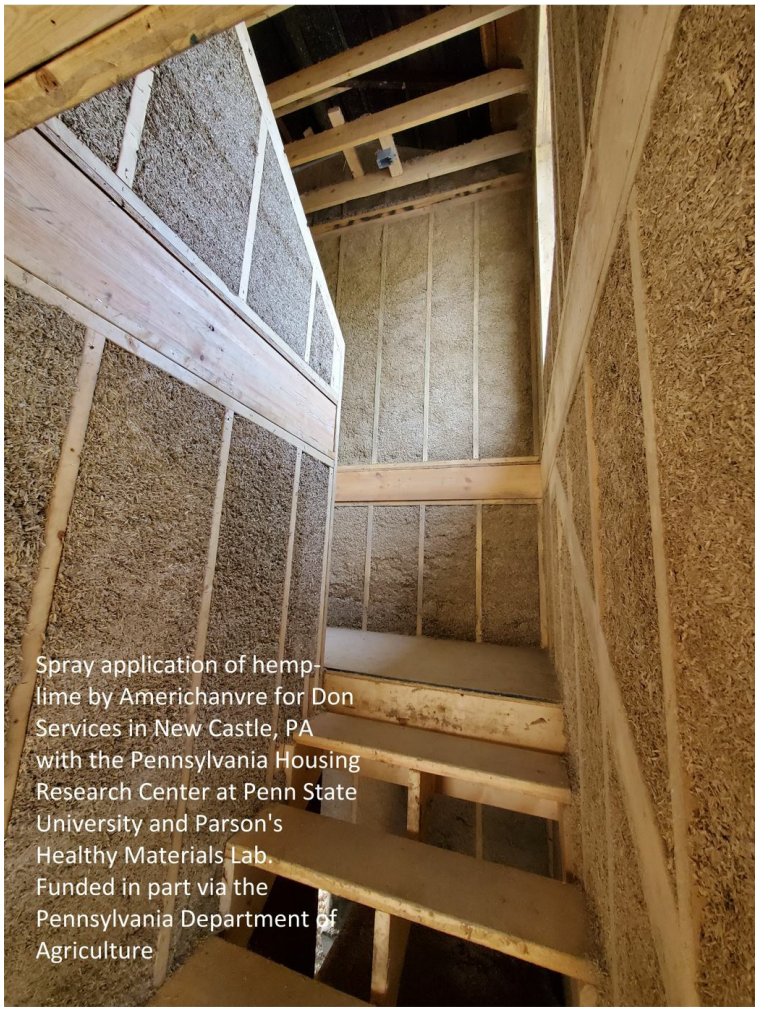
TABLE AY108.1 REFERENCED STANDARDS

STANDARD ACRONYM	STANDARD NAME	SECTIONS HEREIN REFERENCED
ASTM E96-00	*Standard Test Methods for Water Vapor Transmission of Materials*	AY104.1
ASTM C5-10	*Standard Specification for Quicklime for Structural Purposes*	AY104.3.5
ASTM C141/C141M-14	*Standard Specification for Hydrated Hydraulic LIme for Structural Purposes*	AY104.3.5
ASTM C206-14	*Standard Specification for Finishing Hydrated Lime*	AY104.3.5
ASTM C1707-11	*Standard Specification for Pozzolanic Hydraulic LIme for Structural Purposes*	AY104.3.5
ASTM E2392/ ASTM E2392M-10	*Standard Guide for Design of Earth Wall Building Systems*	AY104.3.6.1
CEN EN 459-2015	*Part 1: Building LIme. Definitions, Specifications and Conformity Criteria; Part 2: Test Methods*	AY104.3.5
ASTM C518-21	*Transmission Properties by Means of the Heat Flow Meter Apparatus*	AY106.2
ASTM C1363-19	*Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus*	AY106.2
ASTM C177-19	*Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus*	AY106.2
ASTM C1114-06(2019)	*Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus*	AY106.2
ASTM E84-21a	*Standard Test Method for Surface Burning Characteristics of Building Materials*	AY106.4

Reason: Hemp-lime, commonly referred to as hempcrete, is a non-structural, bio-composite insulation infill material composed of hemp hurd and a lime-based binder. Hemp-lime originated in the mid-1980s in France as a method for renovating historic buildings that required the addition of insulation with sufficient vapor permeability to preserve the structure's integrity. Since then, hemp-lime has been utilized and studied around the world, with its viability demonstrated in thousands of single-family homes, multi-family housing and commercial buildings. The benefits of hemp-lime include high thermal performance, low embodied carbon emissions in production, high carbon sequestration in service, healthy living environments, and high fire-resistance. These benefits, along with the 2018 U.S. legalization of hemp as a commercial crop, are driving rapid growth in interest and projects across the U.S. Hemp-lime provisions in the building code are greatly needed to remove obstacles to its safe and proper use.

Coastal Compound photo courtesy of Tim Callhan

Triangle Housing Project source image



New Castle stairs photo courtesy of Cameron McIntosh

Examples of hemp-lime homes have existed in the U.S. for over a decade, but not until industrial hemp became legal to grow via the Agricultural

Improvement Act of 2018 was there the potential for a U.S. hemp-lime industry. This emerging industry requires the development and availability of regulations in order to expand in a safe and controlled manner. The proposed Hemp-lime (Hempcrete) Construction appendix for the IRC is an important step in this process. This document has been reviewed and has received input from over 25 hemp-lime design and building professionals in the US and around the world, as well as experts in ICC code development.

Hemp-lime modulates interior temperature and humidity, creating a comfortable living environment with its low thermal conductivity, thermal mass, and dynamic hygrothermal effects. Hemp-lime's excellent thermal performance reduces energy use, lowering utility bills while broadly benefiting the environment.

Current construction methods often rely on vapor-closed building envelopes that can promote mold and mildew growth, which reduces interior air quality. Hemp-lime offers a non-toxic insulation option that resists or prevents mold growth. Hemp-lime buildings allow the free passage of water vapor through the exterior walls without creating a point where it becomes trapped to condense. As the binder for hemp-lime is composed primarily of lime, the entire wall system resists mold and mildew growth due to the alkalinity of the lime. This is a major benefit to occupants sensitive to such toxins, as well as others who want to minimize their exposure to mold.

Hemp-lime walls provide a high level of fire resistance because the lime encapsulates the hemp in the matrix. Hemp-lime does not emit smoke or ignite when exposed to direct flame, as demonstrated by European fire tests and an ASTM E84 test where hemp-lime recorded the lowest possible index for flame spread and smoke development.

Though this proposal does not seek a fire-resistance rating, the U.S. hemp industry is planning to conduct an ASTM E119 test to establish a rating for hemp-lime wall assemblies.

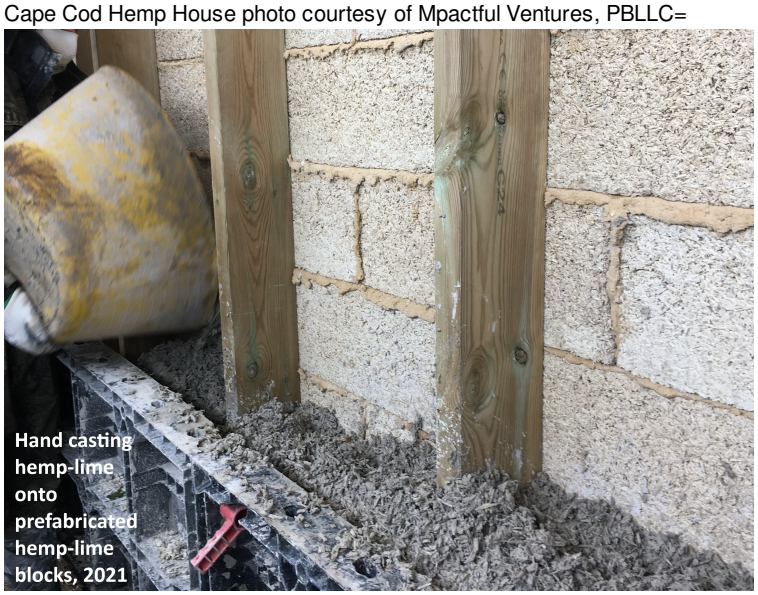
The U.S. government has made lowering its carbon footprint a priority as it tries to meet its global environmental commitments. The building industry accounts for up to 40% of the world's carbon footprint, including both the embodied carbon of materials and the operational impact of buildings. Hemp-lime construction can have an enormous impact with its negative embodied carbon and its high thermal performance that reduces energy use. Industrial-scale hemp crops absorb significant quantities of carbon from the atmosphere, and when used in hemp-lime, its carbon is sequestered for the life of the building. Hydrated lime in the binder also absorbs carbon dioxide as it cures. This presents a major reversal in impact compared with some carbon intensive materials currently used in the building industry.

Supporting documents for the proposed Hemp-lime (Hempcrete) Construction appendix are available at:

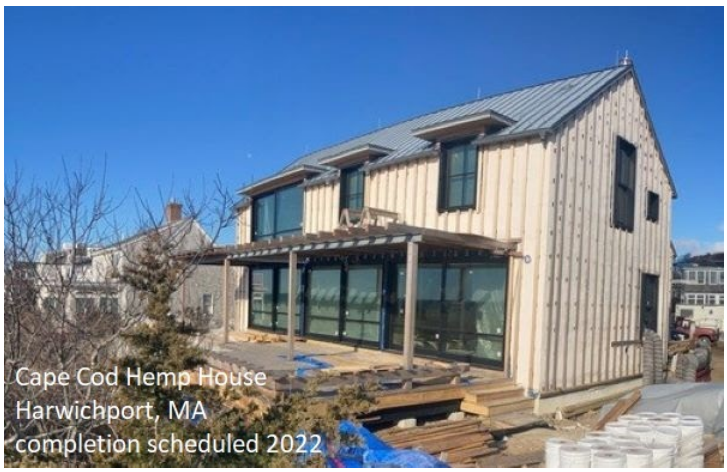
https://ushba.org/icc-supporting-documents/

Appeldorn photo courtesy of Tim Callahan

Cape Cod Hemp House photo courtesy of Mpactful Ventures, PBLLC=



Hand Casting photo courtesy of Graham Durrant



CCHH photo courtesy of Mpactful Ventures

Rationale for Specific Sections of Proposed Appendix Y – Hemp-Lime (Hempcrete) Construction

SECTION AY101 - GENERAL:

Hemp-lime is limited to use as a nonbearing, wall infill material. It primarily functions as insulation and a substrate for finish. Until further seismic testing is done, hemp-lime construction is restricted to use in Seismic Design Categories (SDCs) A, B, and C, except with an approved engineered design. Engineering analysis based on structural and materials tests and accepted engineering practice have determined hemp-lime's safe prescriptive use in SDCs A, B, and C, within the limits of the IRC's structural provisions and this appendix. Testing reports, structural analysis, and other supporting documents are available at: https://ushba.org/icc-supporting-documents/

SECTION AY102 - DEFINITIONS:

Hemp-lime specific terms not found in the IRC are defined. Some definitions are consistent with identical or related terms defined in IRC appendices AR – Light Straw-Clay Construction, AS - Strawbale Construction, and AU - Cob Construction.

SECTION AY103 - HEMP-LIME CONSTRUCTION:

Hemp-lime as a non-structural infill must comply with the Figures in Section AY103 or an approved alternative. The four Figures show different locations of the structural stud wall framing; interior, center, exterior, or double (interior and exterior). These Figures indicate the IRC sections that the foundation, wall framing, floor, and roof/ceiling assembly must comply with, unless otherwise stated in the appendix. They also identify code sections for other elements of a hemp-lime wall. Hemp-lime infill is limited to densities within a range of 12.5 to 25 pcf. This range encompasses the practical and commonly used hemp-lime densities.

The description and requirements of hemp-lime materials in this appendix are based on ASTM standards currently under development, and on input from hemp-lime building professionals and researchers. The binder is restricted to lime based binders because of their well established performance. Most importantly, all materials used in hemp-lime projects must match the materials used in the approved density and integrity test samples required in Sections AY106.3 and AY107.1.

Section AY103.3 contains provisions related to structure. General limits and requirements are given for all hemp-lime buildings, including: 1) maximum one story; 2) maximum building height of 25 feet; 3) braced wall panel lengths, and 4) maximum unit wall weight. Bracing is restricted to the IRC's Method LIB due to the low vapor permeability of braced wall panel sheathing options in the IRC. Structural metal, and all metal in contact with hemp-lime, must be stainless steel or coated to prevent corrosion. Door and window openings are addressed, including the support of hemp-lime by headers with required adjustments. Anchorage rails must be fastened to studs for interior or exterior wall designs, to anchor the hemp-lime to resist out-of-plane forces. Anchorage rails are not required for center and double wall designs, because those stud locations provide sufficient out-of-plane resistance by containment (double wall) or anchoring the hemp-lime in both directions (center wall).

The required minimum spacing between studs is to allow sufficient space to insert the hemp-lime. The required minimum thickness of hemp-lime is to ensure a cohesive infill. Window and door openings must be designed and constructed to prevent water intrusion.

Hemp-lime infill can be installed by hand casting or spray applying on site, or by precasting blocks or panels. Mixing of the material must allow the binder to coat the hemp hurd and to hydrate. Formwork must be vapor permeable or removed within 24 hours to allow the hemp-lime to dry. Hand cast hemp-lime infill must be installed in lifts of no more than 4" to allow a uniform density consistent with approved samples. Spray applied hemp-lime must be installed per the manufacturer's directions for the spray equipment.

Precast blocks and panels are a developing market with great potential. They can be cast by hand, spray equipment, or mechanical means, and can provide highly consistent materials that can be installed ready to be finished. Lined applications provide an easy way to use hemp-lime infill to increase the performance of existing homes. Lined applications must not be used in areas with high moisture content. The appropriateness of hemp-lime lined applications must be evaluated and designed by a registered design professional before use below grade.

Though lime is excellent at inhibiting mold growth and preserving the hemp and wood framing, hemp-lime requires vapor permeable finishes and protection from water intrusion. Water-resistive barriers and vapor retarders are generally prohibited because they interfere with the required vapor permeability and the mechanical bond of plaster. They are allowed only where necessary to prevent water intrusion, for example at horizontal surfaces such as window sills. Interior and exterior air barriers, typically plaster, are essential for optimal thermal performance of hemp-lime walls and to satisfy IRC Section N11024.1.1. Adequate distance between hemp-lime infill and its plaster and the exterior grade is required to protect against water intrusion.

SECTION AY104 - FINISHES:

Hemp-lime infill requires vapor permeable finishes on the interior and exterior of the wall. The finish is necessary to create an air barrier and the high vapor permeability is required to allow vapor to move through the wall. As with many other building materials, hemp-lime infill must be sufficiently dry

before finishes are applied.

Hemp-lime is most commonly finished with plaster. Plaster is best applied directly to the hemp-lime infill.

Membranes must not be applied between the hemp-lime infill and plaster to ensure adequate vapor permeability and a mechanical bond for plaster. Other lath or mesh is not required. Plaster additives are allowed if they do not reduce vapor permeability below the required minimum of 5 perms (the IRC definition of vapor permeable). Reinforcing fibers are allowed to strengthen the plaster. Lime plaster is the most common plaster used on hemp-lime, because of its high vapor permeability and compatibility with the hemp-lime substrate. Clay plaster, with its even higher vapor permeability, is also acceptable for hemp-lime. Exterior clay plaster must be protected with a more durable material. Clay-lime and hemp-lime plasters have also been successfully used on hemp-lime.

When wood members are on the surface of the wall where plaster is to be applied, it is necessary to cover the wood with a water-resistive barrier unless the wood is otherwise protected from water. Exterior clay plaster can be in direct contact with wood, because clay's hygroscopic properties protect wood from moisture damage.

Where plaster is to be applied to hemp-lime adjacent to another material, a bridging material is required to reinforce the plaster. The bridging material strengthens the plaster, improves bonding, and prevents cracking. Recessed window and door openings in hemp-lime infill must be designed to prevent water intrusion.

Non-plaster exterior cladding can be used over hemp-lime infill. The hemp-lime must be covered with a vapor permeable air barrier such as lime plaster, and an air gap must be provided between the hemp-lime wall and the exterior cladding that is vented to allow air movement. The exterior cladding can have a water-resistive barrier behind it.

In high moisture conditions, such as showers or steam rooms, a water-resistant finish must be applied on the interior side of exterior hemp-lime walls.

SECTION AY105 - FIRE RESISTANCE:

Hemp-lime is known for its fire-resistive properties through tests in Europe. When structural members are surrounded by hemp-lime infill, it can protect them from fire. However because ASTM E119 or UL263 tests have not yet been performed, a fire-resistance rating is not included in this proposal.

SECTION AY106 - THERMAL PERFORMANCE:

Hemp-lime walls provide well-balanced thermal performance, with a combination of low thermal conductivity, thermal mass, and hygrothermal effects. Hemp-lime walls in this appendix are classified as mass walls per Section N1102.2.5, if their heat capacity is greater than 6 Btu/ft2 x°F. An Equation is given to calculate a mix's heat capacity.Hemp-lime infill's density is a determining factor of its R-value. The lower the density, the higher the R-value per inch. The relationship of density to unit R-value in Table AY106.2 was determined from a thorough review of research and testing.

In order to determine the density of the hemp-lime infill, samples are made from the materials to be used to construct the hemp-lime infill and tested following a specified procedure representative of the planned installation method.A hemp-lime ASTM E84 test conducted in 2020 yielded the lowest possible values, thus easily meeting the IRC requirements in R302.10.1 for flame spread index and smoke-developed index for insulating materials in wall assemblies.

SECTION AY107 - MECHANICAL PERFORMANCE:

Though hemp-lime infill is not structural, it must be capable of bearing its own weight and maintaining its integrity for the lifetime of the wall. To determine the integrity of the hemp-lime infill, a compression test must be performed on a representative sample made with the materials to be used to construct the hemp-lime infill, created using a procedure representative of the planned installation method.

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Tradical (2018) Tradical Hempcretes [Brochure] https://www.bcb-tradical.com/wp-content/uploads/2018/02/Tradical-Hempcrete-brochure.pdf

Cost Impact: The code change proposal will not increase or decrease the cost of construction
As a wall system, hemp-lime construction can be more costly or less costly than conventional wall systems in the IRC, depending on many variables. Hemp is inexpensive, some lime binders are of modest expense while some proprietary lime binders are expensive. Installing hemp-lime is labor intensive, but in one installation it provides insulation, thermal mass, and a substrate for finish.

Clay plasters use the inexpensive materials of clay subsoil (often from the site) and sand. The lime binder in lime plasters is more costly than clay subsoil, as well as the Portland cement binder used in conventional cement plaster. Clay, lime, and cement plasters all require a similar amount of labor. However unlike cement plaster over wood-frame walls, clay and lime plasters applied to hemp-lime infill do not require wire lath or a water-resistive barrier.

Other elements or systems in a hemp-lime building such as the foundation, roof/ceiling, electrical, plumbing and mechanical are typically similar to those used in conventional construction and therefore of similar cost.

On average, this proposal will not affect the cost of construction.

Staff Analysis: The following standards are already referenced in the IBC:

- CEN/EN 459-2015 Part 1: Building Lime. Definitions, Specifications and Conformity Criteria; Part 2: Test Methods
- ASTM C141/C141M-14 Standard Specification for Hydrated Hydraulic Lime for Structural Purposes
- ASTM C206-14 Standard Specification for Finishing Hydrated Lime
- ASTM E2392/E2392M-10 Standard Guide for Design of Earthen Wall Building Systems.

Also, the following are are also referenced in the current codes but under newer versions. These are simply new occurrences of the references in the I-Codes.

- ASTM E96-00 Standard Test Methods for Water Vapor Transmission of Materials
- ASTM C5-10 Standard Specification for Quicklime for Structural Purposes
- ASTM C1707-11 Standard Specification for Pozzolanic Hydraulic Lime for Structural Purposes

A review of the following standards proposed for inclusion in the code, and , with regard to some of the key ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before March 16, 2022.

- ASTM C518-21 Transmission Properties by Means of the Heat Flow Meter Apparatus
- ASTM 1363-19 Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
- ASTM C177-19 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- ASTM C1114-06(2019) Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus,

The proposal is referencing an updated version of an existing referenced standard . Therefore the updated version is considered an new standard. A review of the standard proposed for inclusion in the code, with regard to some of the key ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before March 16, 2022.

- ASTM E84-21a Standard Test Method for Surface Burning Characteristics of Building Materials,