Castle Pines
Transportation Master Plan

October 2025

CITY OF
CASTLE PINES

City of Castle Pines

Transportation Master Plan

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Prepared For:

CITY OF CASTLE PINES

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Executive Summary

The Transportation Master Plan (TMP) is a comprehensive guide designed to shape the future of mobility in Castle Pines. As the City continues to grow and evolve, it is essential to ensure that the transportation system supports the needs of residents, businesses, and visitors while promoting safety and efficiency. This Plan will address current challenges, outline future needs, and propose solutions to improve mobility across all modes of transportation. The TMP will create a roadmap for a well-connected, accessible, and resilient transportation system that enhances the quality of life for all who live and work in Castle Pines.

Castle Pines is a largely auto-dependent community. Residents commonly leave the community to access general services and to travel to work, while local workers travel from outside of Castle Pines to fill the jobs available in the community. This dynamic causes a heavy reliance on Castle Pines Parkway and Monarch Boulevard for travel within the City, and on I-25 for regional travel. Castle Pines is likely to remain highly dependent on single-occupancy vehicle travel for the foreseeable future. However, Castle Pines residents have identified a desire for increased multimodal transportation options.

Although Castle Pines offers an extensive network of paved recreational trails, the network is not well-connected in all places, and on-street bicycle and pedestrian facilities are inconsistent. As a result, completing local trips by bicycling or walking can be challenging. To meet the changing needs of its residents, Castle Pines can pursue a multimodal transportation system that balances the need for increased transportation options while ensuring efficient flow of vehicle traffic.

Additionally, Castle Pines must confront its existing infrastructure needs. Maintenance costs for City-owned roads are increasing, as much of the infrastructure is now decades old. Due to the impacts of weather and regular usage, some roadways will need to be rehabilitated or replaced in the near future. With these challenges comes the opportunity to rethink the form and function of City roadways. In particular, roadway reconstruction provides Castle Pines with a chance to create a transportation system that meets the needs of a greater range of users, while preserving vehicular access into and out of the community.

The Transportation Master Plan builds upon the *Castle Pines Comprehensive Plan*. Where the Comprehensive Plan identifies issues and priorities, the TMP contains multiple implementation measures that address the City's infrastructure needs and support the Comprehensive Plan's goals and objectives. Implementation measures include roadway design guidance, community-specific design elements, policy recommendations, and implementation matrix.

Another priority for Castle Pines is providing safe access to schools. The infrastructure currently in place is not sufficient to support high volume time periods, like drop-off and pick-up, which creates issues with queue lengths and times. The Transportation Master Plan identifies these issues related to traffic operations and student safety, and recommends solutions at the following schools: Buffalo Ridge Elementary School, American Academy, Timber Trail Elementary School, and DCS Montessori School.

Introduction

Having been incorporated in 2008, the City of Castle Pines is still a budding community that is working to build its own unique identity. The City has tremendous opportunity for growth, including new residential and commercial development. With this growth, comes a need for an efficient and safe transportation system that meets the City's needs well into the future.

Castle Pines is located along Interstate 25 (I-25) in Douglas County, in the southern part of the Denver Metropolitan Area. Many of its residents rely on I-25 for their commute to work. Additionally, many jobs within the City are held by non-residents who commute into Castle Pines. As new development occurs in the City, there are expected to be more opportunities for people to live, work, and shop in Castle Pines.

Many residents depend on personal automobiles for transportation. This is typical of suburban cities that are primarily residential in character. However, Castle Pines residents have expressed interest in developing a multimodal transportation network that reduces dependence on automobiles and expands opportunities for walking, biking, and transit. Therefore, multimodal transportation is a major consideration in this Transportation Master Plan (TMP).

The TMP builds upon previous planning efforts by the City, most importantly the *Castle Pines Comprehensive Plan*. The Comprehensive Plan articulates the community's shared values and sets forth its vision for the future in five key areas, including those related to transportation. The TMP then provides specific and actionable steps to achieve its established transportation vision. Furthermore, the goals and objectives of the TMP are directly based on those described in the Comprehensive Plan.

Based on the goals and objectives described in the Comprehensive Plan, the TMP identifies the following key issues to be addressed in order to achieve the City's transportation goals:

- Community Character
- Site Access and Local Connectivity
- Bicycle and Pedestrian Facilities

These issues should serve as guiding principles for the City's transportation vision. Therefore, the recommendations provided in this TMP are expected to solve these issues.

The TMP makes specific and actionable recommendations on transportation solutions and policy options. As discussed in this TMP, transportation solutions include multimodal, school traffic improvements, and community-specific improvements related to roadway design guidance. Additionally, the TMP recommends a number of new transportation policies.

Goals and Objectives

Table 1: Goals and Objectives

Goals	Objectives
Goal I: Develop a safe, efficient, multi-functional transportation network designed to promote connections to local destinations.	• Connect adjoining neighborhoods, schools, community facilities, and services (public/private). • Ensure consistency of local, regional, and statewide transportation plans. • Support traffic calming and streetscape design on local streets. • Expand network connectivity with parallel east/west and north/south routes through construction of new roads or connection of existing roads.
Goal II: Facilitate cost-effective operations and roadway maintenance strategies.	• Uphold the quality, connectivity, and maintenance of local and arterial roadways. • Provide adequate primary, secondary, and emergency road connections for all neighborhoods. • Improve efficiency of travel along principal arterials through smooth traffic flows.
Goal III: Develop the bicycle infrastructure network to support increased commuting trips and serve the needs of all types of cyclists.	• Create a continuous paved path system around the City, connecting neighborhoods, parks, schools, and commercial areas. • Complete a system of connected on-street and off-street bicycle facilities along or parallel to major roads. • Develop programs that encourage bicycling activity, including education and training. • Enhance bicycle access to commercial destinations, both local and regional. • Consider e-bikes and scooters in planning and design.
Goal IV: Increase pedestrian connectivity, accessibility, safety, and comfort.	• Create comfortable and safe pedestrian connections and crossings that encourage walking. • Complete a system of connected on-street and off-street pedestrian facilities along or parallel to major roads. • Develop programs that encourage pedestrian activity, including education and training. • Enhance pedestrian access between neighborhoods, schools, and commercial destinations.
Goal V: Facilitate future opportunities for Castle Pines residents to access regional destinations via public transit.	• Support multimodal transportation solutions, such as microtransit, to connect residents to the nearby RidgeGate Parkway Station. • Identify potential sites for public transit facilities and related pedestrian and bicycle connections.
Goal VI: Develop transportation infrastructure that supports transit oriented development (TOD).	• Anticipate potential microtransit, rail expansion, and park-and-rides adjacent to I-25. • Enhance vehicular, pedestrian, and bicycle connectivity and mobility within all mixed-use developments. • Encourage transit oriented development (TOD) near the I-25 interchanges at Castle Pines Parkway and Happy Canyon Road.

City Profile

Demographics

Population and Housing

Castle Pines is a primarily residential community located in Douglas County, in the southern Denver metropolitan area. According to population estimates by the Census, Castle Pines had a population of approximately 11,036 people in 2020.[1]

As of 2023, housing in Castle Pines is comprised of approximately 4,628 housing units, predominantly single-family units at 90%, while 10% of units are multi-family.[2] The percentage of single-family homes in Douglas County is at approximately 80%, while single-family homes make up only 51% of housing in the City and County of Denver. A high percentage of Castle Pines households are owner-occupied (84%), which is consistent with the suburban residential character of the community. In comparison, only 47% of households in Denver are owner-occupied.

According to the 2021 Castle Pines Comprehensive Plan, the estimated median home price in Castle Pines was $714,976. As of 2023, the median household income in Castle Pines is $189,918, which is nearly $47,000 more per year than the median household income for Douglas County, and approximately $95,000 more per year than that of Denver. However, this has created concerns among low income earners about not being able to afford home prices.

According to the 2020 Decennial Census, the racial composition of Castle Pines is 85% White, 1% Black or African American, 3% Asian, and 8% two or more races, while 7% identify as Hispanic or Latino. The racial composition of Douglas County is similar, with 78% White, 1% Black or African American, 5% Asian, 1% some other race, and 5% two or more races, with 10% identifying as Hispanic or Latino.

Employment

Castle Pines residents are largely employed outside of the City and work significantly in white collar occupations. According to the "OnTheMap (Employment)" interactive Census map, the most common professions among Castle Pines residents include the finance and insurance sector; professional, scientific, and technical services; and the health care and social assistance sector.

[1] 2020 Decennial Census, US Census Bureau
[2] 2023 American Community 5-Year Estimates

Table 2: Castle Pines Workforce by Industry

Jobs by NAICS (2022)	Jobs Held by Castle Pines Residents	Jobs Located in Castle Pines	Jobs Located in Denver MSA
Agriculture, Forestry, Fishing, and Hunting	0.1%	0.0%	0.3%
Mining, Quarrying, and Oil and Gas Extraction	0.6%	0.0%	0.6%
Utilities	0.4%	0.6%	0.4%
Construction	4.7%	4.7%	6.5%
Manufacturing	3.8%	0.4%	4.7%
Wholesale Trade	5.1%	7.3%	5.1%
Retail Trade	7.9%	17.7%	9.0%
Transportation and Warehousing	2.9%	3.3%	4.9%
Information	5.3%	1.8%	3.7%
Finance and Insurance	8.7%	4.8%	5.5%
Real Estate, Rental, and Leasing	2.4%	1.5%	2.2%
Professional, Scientific, and Technical Services	14.8%	17.9%	11.4%
Management of Companies and Enterprises	3.7%	4.4%	2.5%
Administration and Support, Waste Management, and Remediation	5.2%	3.8%	6.5%
Educational Services	7.2%	4.3%	6.5%
Health Care and Social Assistance	11.9%	12.4%	12.4%
Arts, Entertainment, and Recreation	2.3%	0.8%	1.9%
Accommodation and Food Services	7.4%	10.5%	8.4%
Other Services (excluding Public Administration)	2.6%	3.1%	3.1%
Public Administration	3.0%	0.6%	4.5%
Total Jobs	**5,771**	**2,053**	**1,584,903**

Source: OnTheMap (Employment), United States Census Bureau, 2022

Jobs available in Castle Pines are disproportionately found in the retail, trade and accommodation, and food service industries. However, retaining these fields has posed a challenge to the City and indicates that Castle Pines must grow beyond the demand generated by a commuter economy. Due to the relatively low incomes associated with these jobs, affordability, and lack of attractive opportunities, Castle Pines needs to import much of its workforce from surrounding areas. As a result, service sector jobs are primarily filled by workers who reside outside of the City. A high share of jobs in Castle Pines are also found in the professional, scientific, and technical service sector, although it is possible that many of these jobs are filled by residents who work from home.

Commuting

Many of the employed residents in Castle Pines travel outside the City and Douglas County to reach their place of work. According to the OnTheMap workforce data shown in **Table 2**, which

shows the workforce percentages per industry by Castle Pines residents, the most conservative estimate would indicate that approximately 36% of jobs located in Castle Pines are held by Castle Pines residents. The remaining 64% of residents commute outside of city limits in order to reach their place of work.

Since there are limited opportunities to both live and work in Castle Pines, there is a heavy reliance on I-25 for commuting. Work sites of employed residents are dispersed across the Denver metropolitan area, with concentrations in Downtown Denver, the Denver Tech Center, along I-25 through Centennial and Lone Tree, and to the south in Castle Rock.

Figure 1 shows the travel distances for Castle Pines residents commuting to work. 84% of residents commute less than 25 miles. This is similar to Douglas County overall, in which 81% of residents have a commute shorter than 25 miles. For comparison, 91% of Denver residents commute less than 25 miles, and 66% commute less than 10 miles. As shown in **Figure 2**, approximately 62% of Castle Pines residents commute to work by private vehicle. Approximately 1% used public transportation, 4% used a taxicab, motorcycle, or other means, and 34% worked from home. The majority of employed residents in Castle Pines have their own vehicles, with 88% of households having two or more vehicles available.

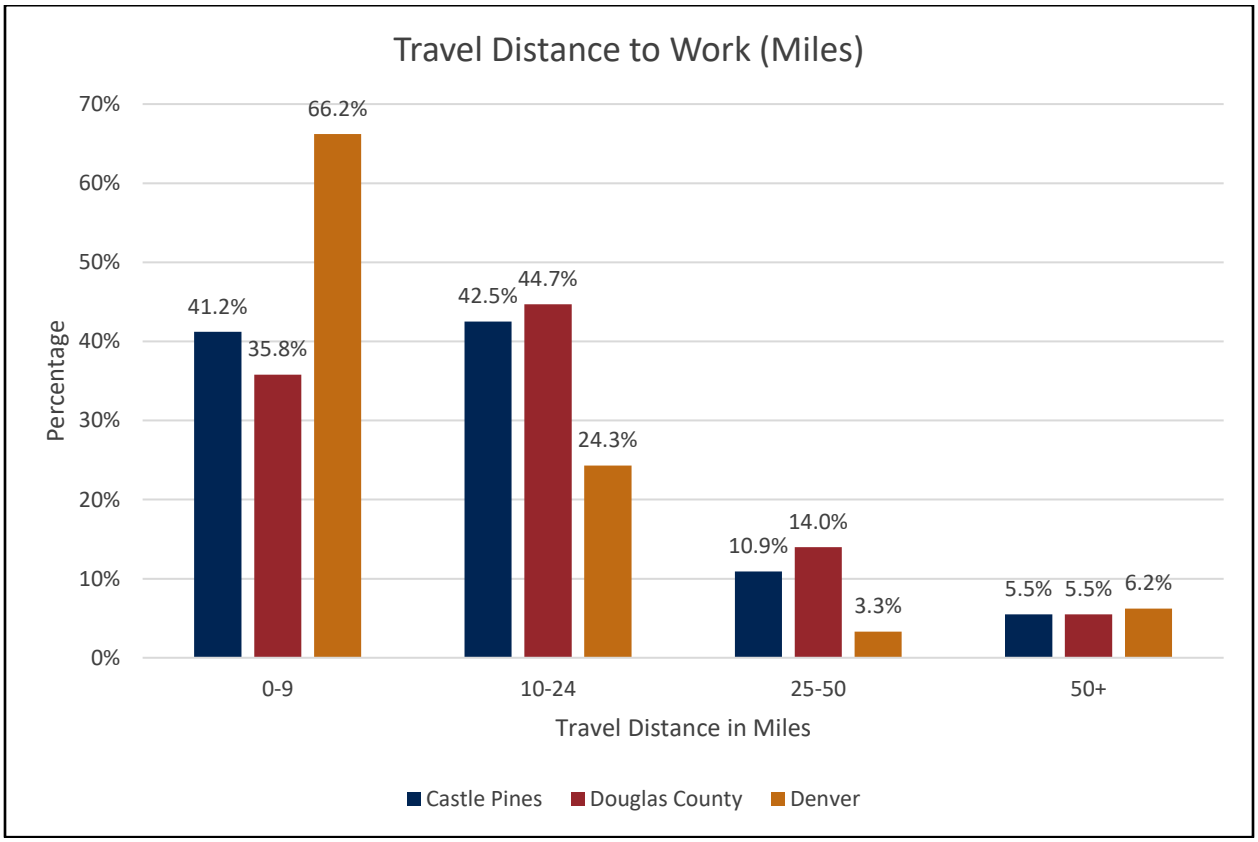


Figure 1: Travel Distance to Work (Miles)
Source: OnTheMap (Employment), United States Census Bureau, 2022

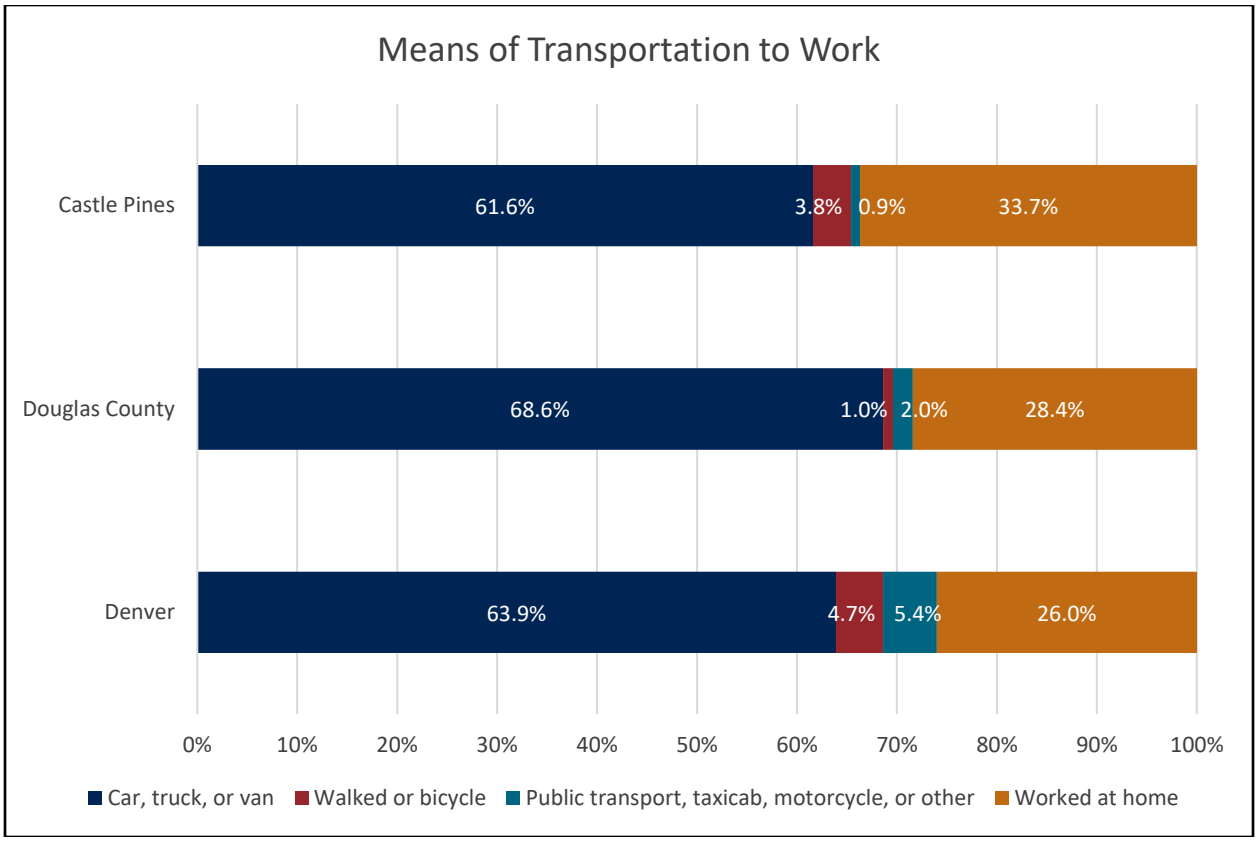


Figure 2: Means of Transportation to Work
Source: 2023 American Community 5-Year Estimates

Employment and Housing Projections

According to the 2050 population and employment forecasts developed by DRCOG, Castle Pines is expected to grow significantly, particularly east of I-25 as a result of The Canyons planned development. There is also anticipated growth west of I-25 in the Castle Pines town planned development. The employment projections between the Year 2020 and Year 2050, based on DRCOG's forecasts, can be seen in **Figure 6** and **Figure 7** respectively, and the employment growth is shown on **Figure 8**. Most areas west of I-25 anticipate employment growth from 1% to 100%, however some areas east of I-25 forecast employment growth from 101% to 500% due to the new developments occurring east of I-25.

According to the 2021 Castle Pines Comprehensive Plan, the City's population is anticipated to grow to 35,000 residents in 2040. Approximately 350 new housing units were built in the City between 2015 and 2019, with 413 new single-family building permits issued in 2020. The Canyons development is expected to result in approximately 5,000 residential units. The Town Center is anticipated to include up to 475 single-family households and 200 multi-family households. The Lagae Ranch development will create an additional 563 single-family homes. The currently developed areas of Castle Pines to the west of I-25, with the exception of the Town Center and Lagae Ranch, are not expected to experience significant population or employment growth in the future.

Figures 3-8 depict total population and employment by transportation analysis zone (TAZ) – a unit of analysis used for regional transportation planning – for the years 2030 and 2050, as well as growth rates from 2030 to 2050. TAZ-level forecasts are developed by DRCOG for the entire Denver metropolitan area, while projections for Castle Pines were developed by DRCOG in coordination with Douglas County staff. Since there is inherent uncertainty in predicting actual growth by location, the future year maps should be referenced for understanding general growth patterns across Castle Pines and the surrounding area. It is important to note that TAZs are not consistent with jurisdictional boundaries. Therefore, some zones primarily located within Castle Pines may appear more heavily developed than they actually are as the populated portions of the zones are outside of city limits.

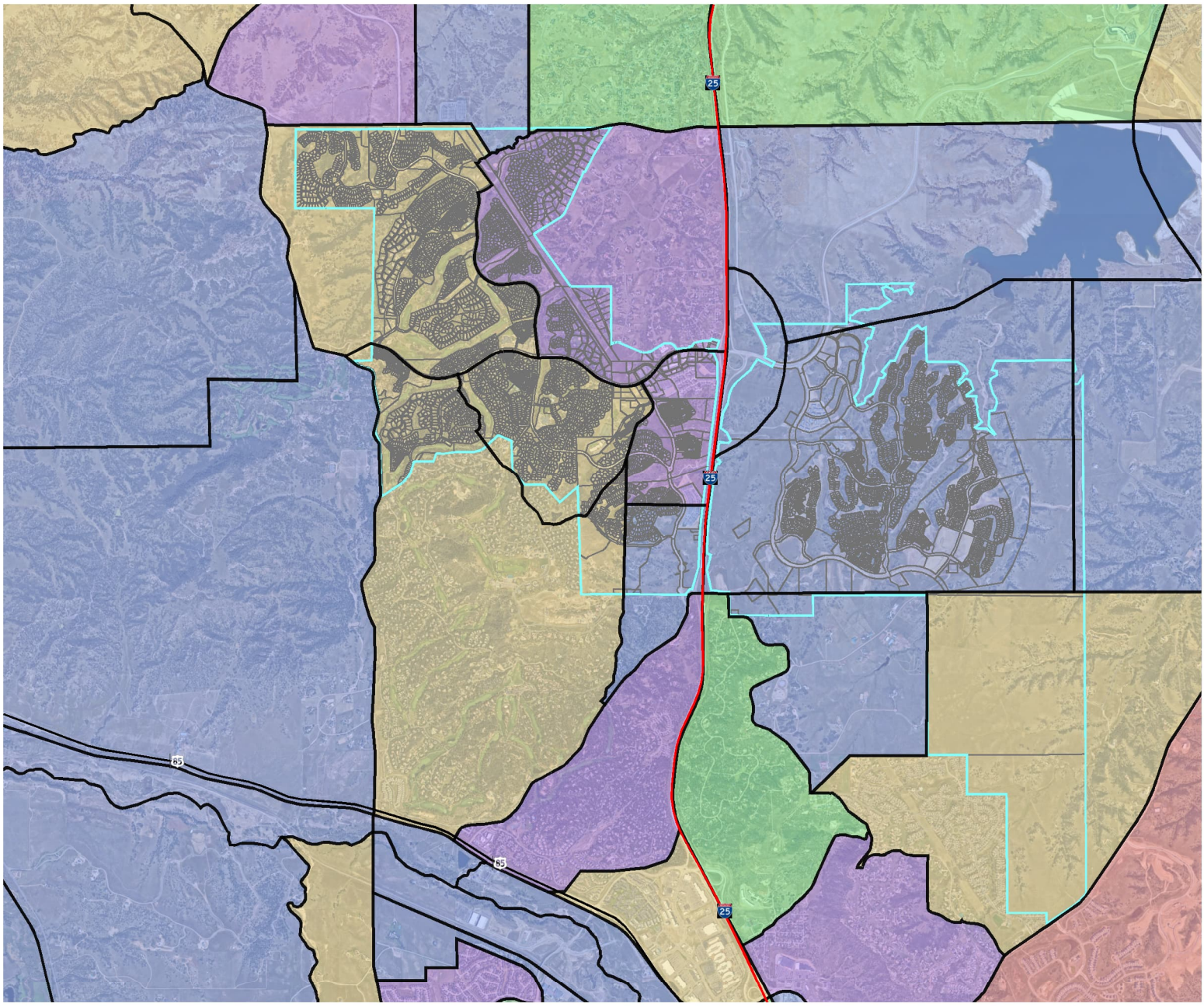


Figure 3: Population By Zone (2020)

Note that transportation analysis zones (TAZs) are not consistent with jurisdictional boundaries. Therefore, some zones primarily located within Castle Pines may appear more heavily developed than they actually are as the populated portions of the zones are outside of municipal limits.

Legend
- Castle Pines City Limits
- Interstate Highway
- US Highway
- County & Local Roads

Population 2020
- 0–500
- 501–1000
- 1001–2500
- 2501–5000
- >5000

N

5000 2500 0 5000

ORIGINAL SCALE: 1" = 5000'

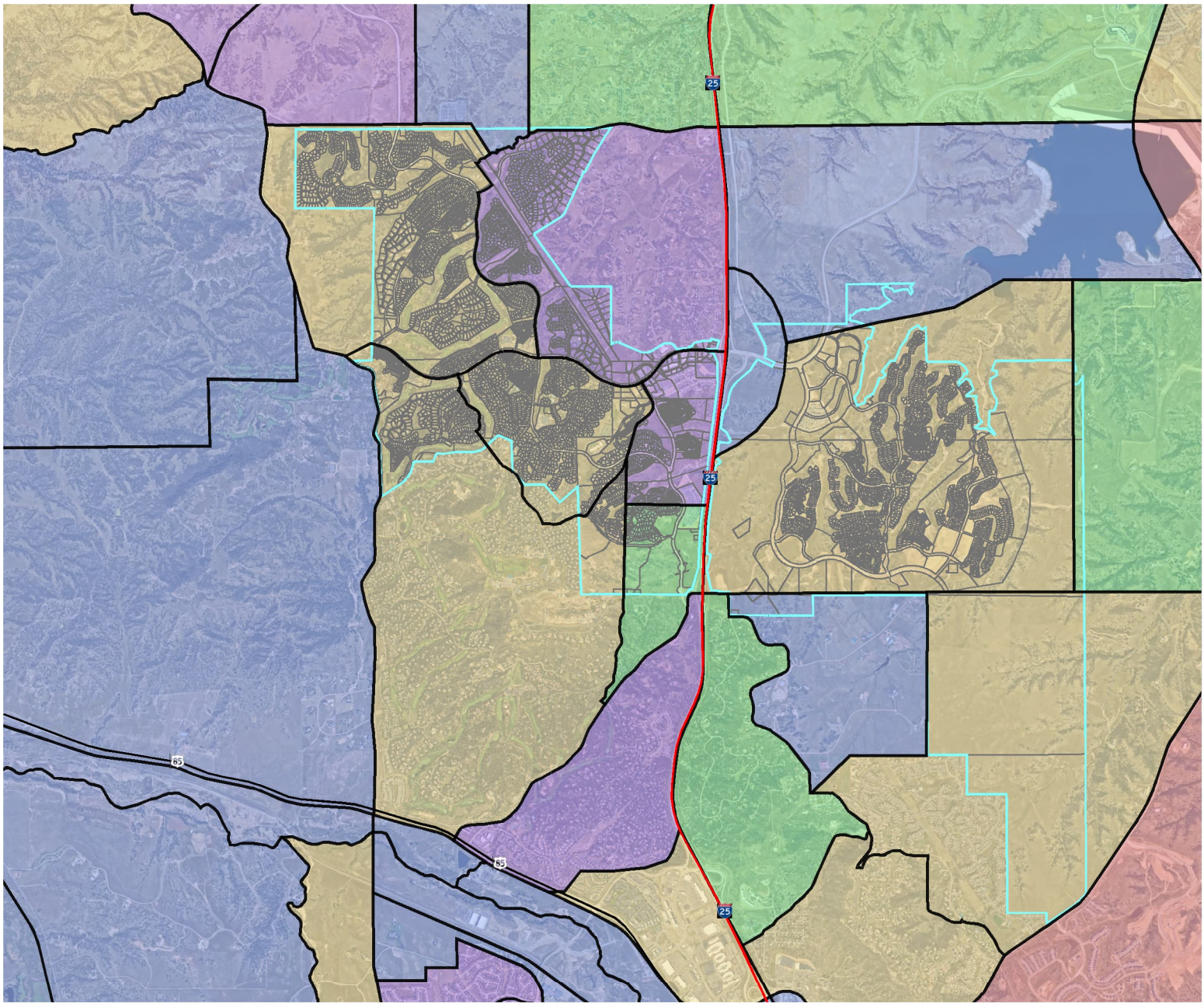


Figure 4: Population By Zone (2050)

Note that transportation analysis zones (TAZs) are not consistent with jurisdictional boundaries. Therefore, some zones primarily located within Castle Pines may appear more heavily developed than they actually are as the populated portions of the zones are outside of municipal limits.

Legend
- Castle Pines City Limits
- Interstate Highway
- US Highway
- County & Local Roads

Population 2050
- 0–500
- 501–1000
- 1001–2500
- 2501–5000
- >5000

N

5000 2500 0 5000

ORIGINAL SCALE: 1" = 5000'

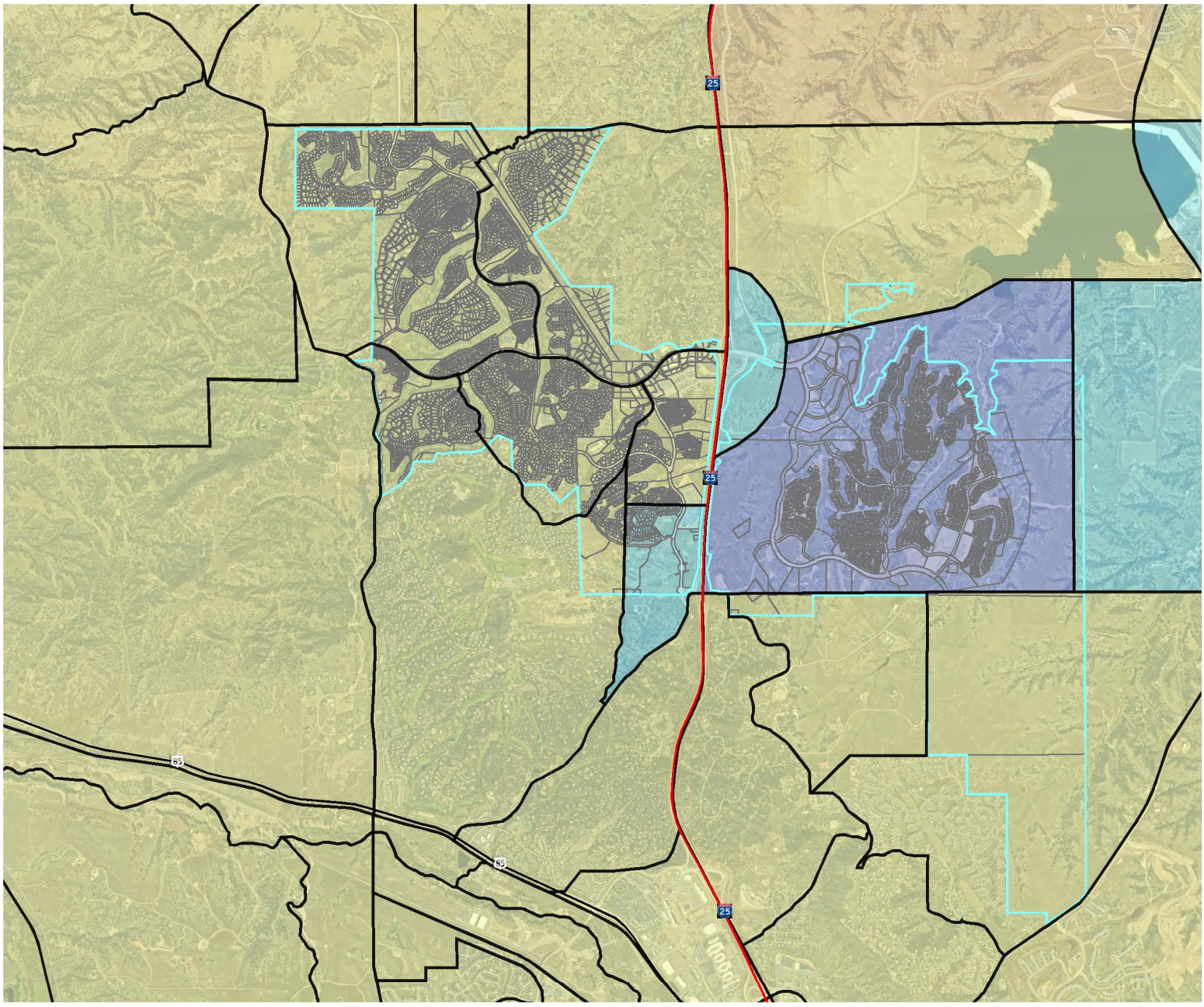


Figure 5: Population Growth by Zone (2020-2050)

Note that transportation analysis zones (TAZs) are not consistent with jurisdictional boundaries. Therefore, some zones primarily located within Castle Pines may appear more heavily developed than they actually are as the populated portions of the zones are outside of municipal limits.

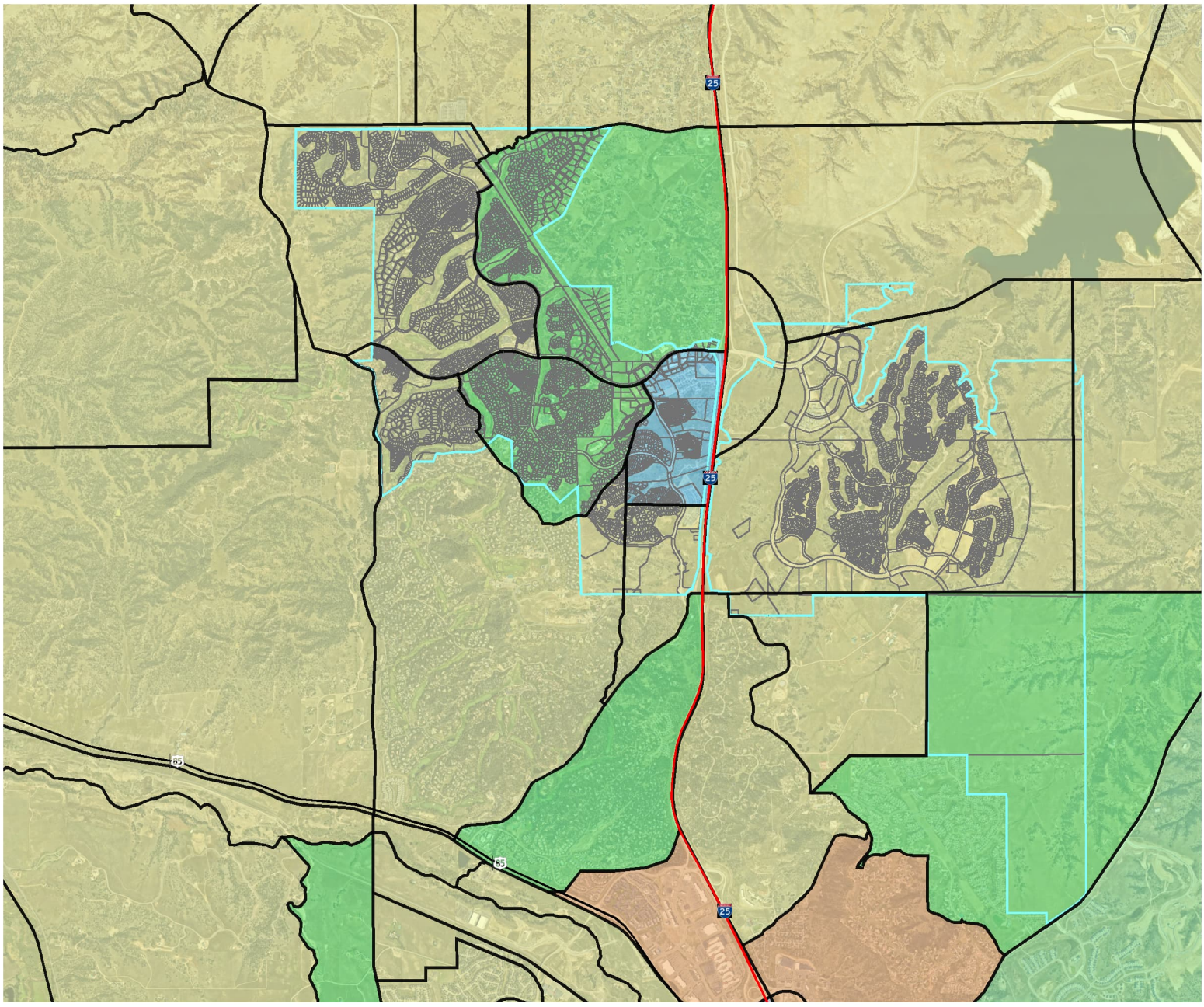


Figure 6: Employment By Zone (2020)

Note that transportation analysis zones (TAZs) are not consistent with jurisdictional boundaries. Therefore, some zones primarily located within Castle Pines may appear more heavily developed than they actually are as the populated portions of the zones are outside of municipal limits.

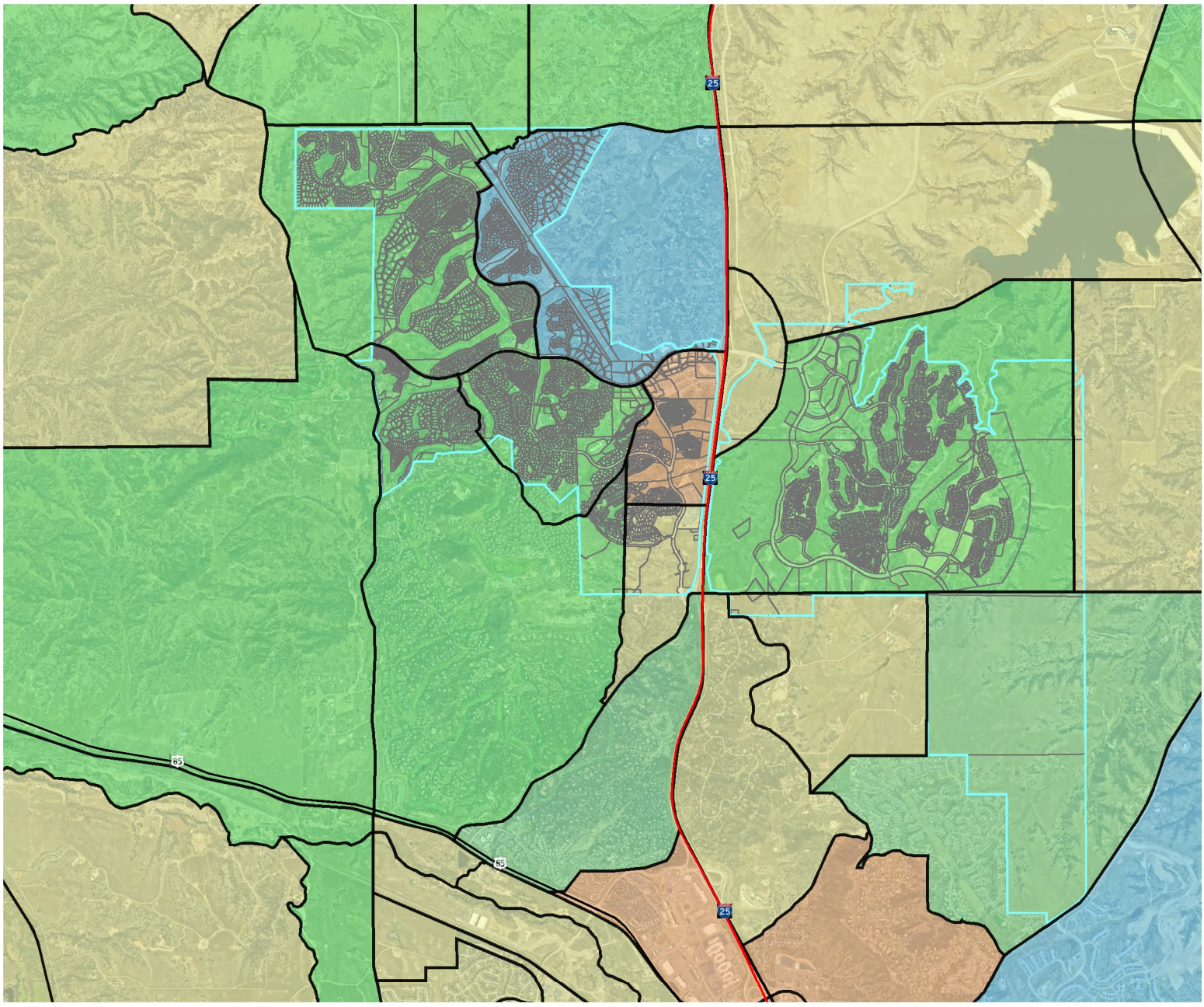


Figure 7: Employment By Zone (2050)

Note that transportation analysis zones (TAZs) are not consistent with jurisdictional boundaries. Therefore, some zones primarily located within Castle Pines may appear more heavily developed than they actually are as the populated portions of the zones are outside of municipal limits.

Legend
- Castle Pines City Limits
- Municipal Boundaries
- Interstate Highway
- US Highway
- County & Local Roads

Employment 2050
- 0–350
- 351–750
- 751–1500
- 1501–3500
- >3500

N

5000 2500 0 5000

ORIGINAL SCALE: 1" = 5000'

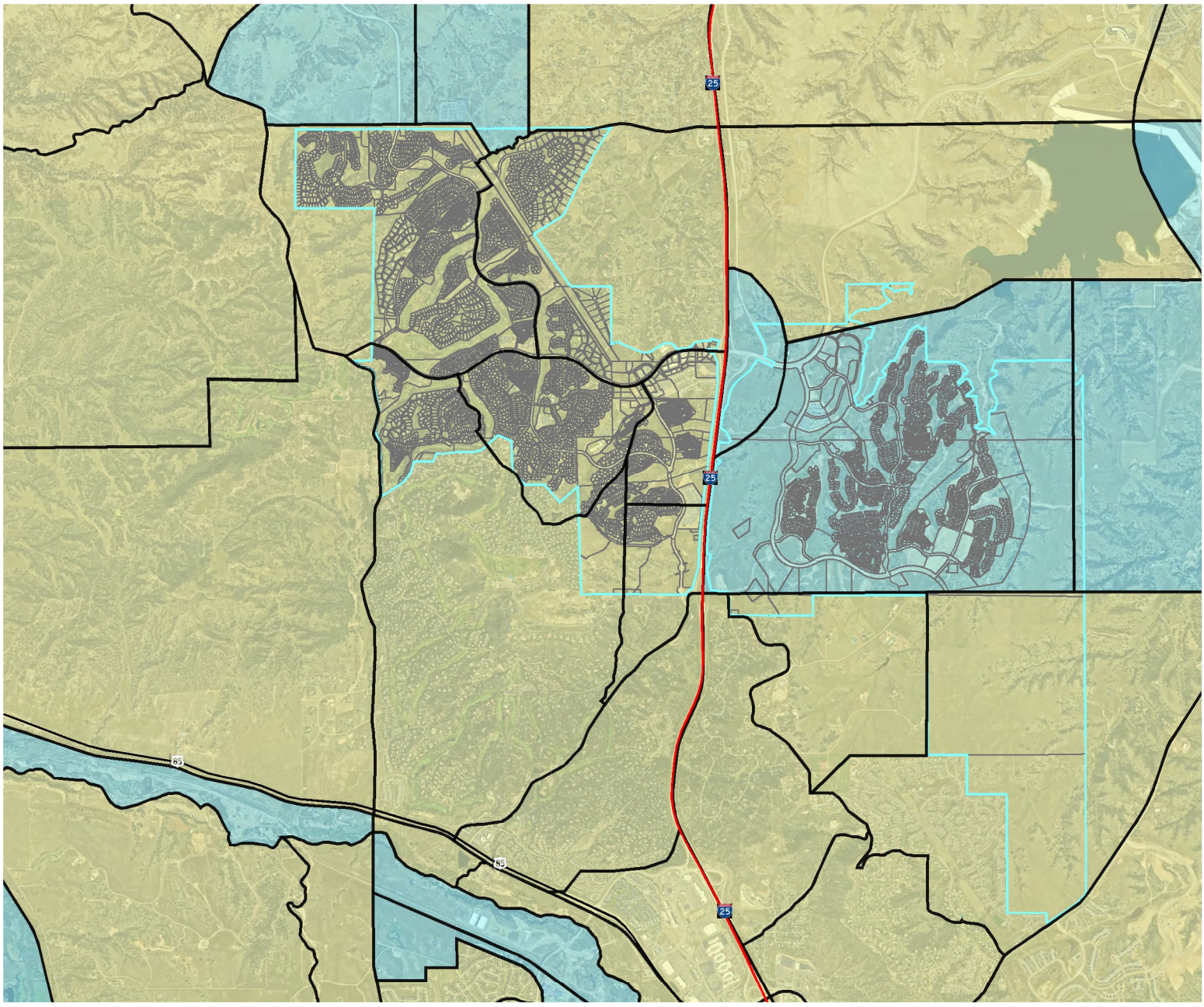


Figure 8: Employment Growth by Zone (2020-2050)

Note that transportation analysis zones (TAZs) are not consistent with jurisdictional boundaries. Therefore, some zones primarily located within Castle Pines may appear more heavily developed than they actually are as the populated portions of the zones are outside of municipal limits.

Existing Transportation Network

Roadways

Castle Pines is bisected east/west by I-25, a major interstate highway that provides regional connection across the Colorado Front Range. Many residents rely on I-25 for their commute to work. The City has two direct accesses to I-25 at Castle Pines Parkway and Happy Canyon Road.

Connectivity within the City is provided by a few major roadways. The Castle Pines Parkway and Happy Canyon Road interchanges provide east-west connectivity across I-25. On the west side of Castle Pines, north-south connectivity is provided by Lagae Road and Monarch Boulevard. This Plan proposes that Monarch Boulevard north of Castle Pines Parkway be designated as an arterial roadway, which is a change from the previous *2017 Master Transportation Plan*. East of I-25, north-south connectivity is provided by Canyonside Boulevard, which is planned to connect to Crowfoot Valley Road to the south.

The majority of roads in Castle Pines are local or collector roadways, which are roadways that provide land access and traffic circulation within residential, commercial, and business areas and connect to arterial roadways. These roads do not provide connectivity across the City, but provide access to the City's arterial roads, which are defined as roadways primarily used by through traffic in order to deliver traffic from collectors to highways or expressways (for example, Castle Pines Parkway and Monarch Boulevard). Multiple roads also connect Castle Pines with nearby communities. Monarch Boulevard and Daniels Park Road connect to Lone Tree and Highlands Ranch to the north. To the south, connections to Castle Rock can be made via Daniels Park Road and Lagae Road/Happy Canyon Road. Additionally, Hess Road leads east to Parker.

Canyonside Boulevard

Figures 9-20 depict the existing roadway network, existing and proposed intersection control, average daily traffic (ADT), and levels of service (LOS). The level of service along a given roadway was determined using the average daily traffic, number of travel lanes, and posted speed limit. A letter grade ranging from LOS A (best, free-flowing conditions) to LOS F (worst, unstable, high delay conditions) was then assigned.

Castle Pines Parkway

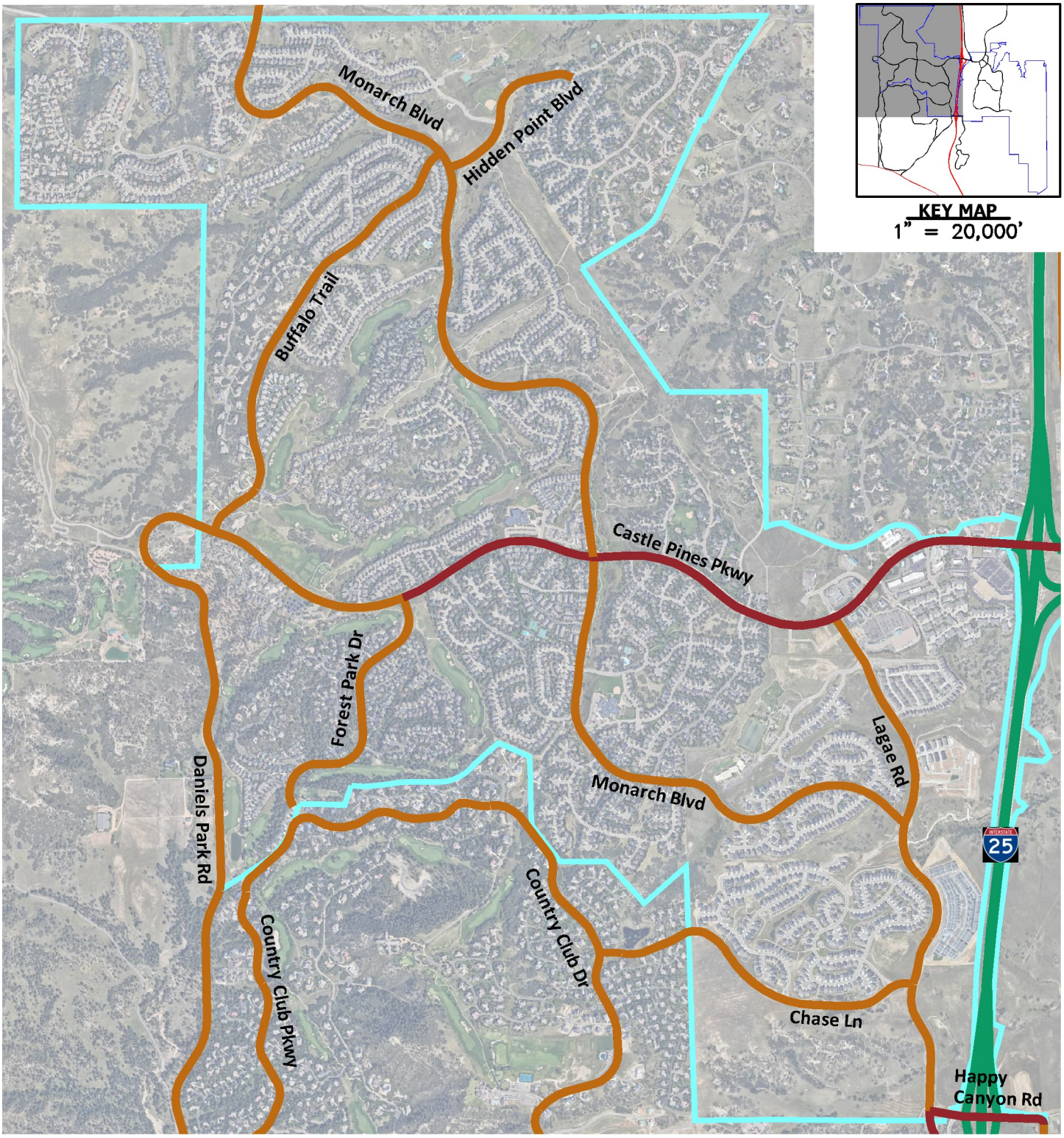


Figure 9: Existing Roadway Network (West)

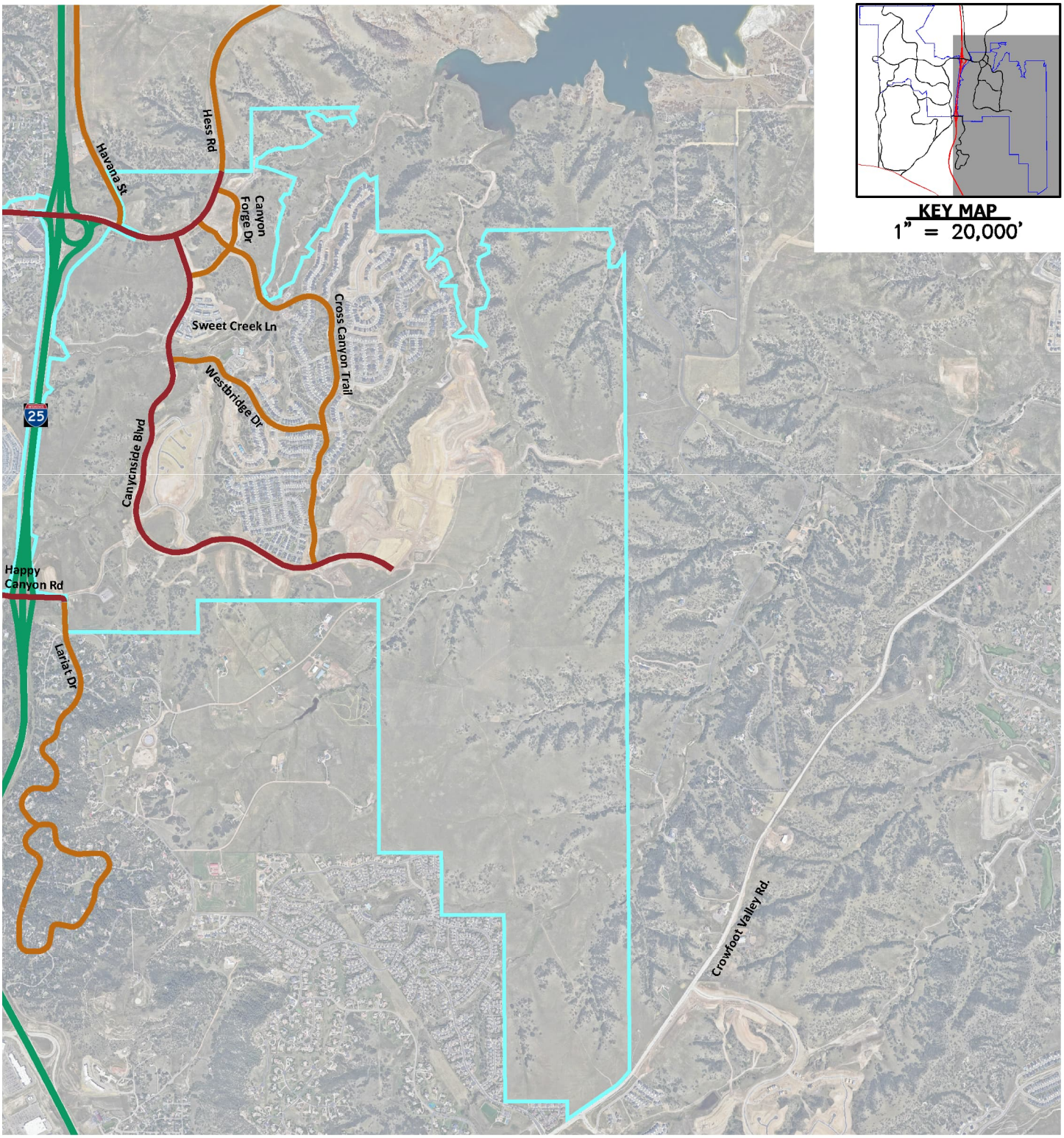


Figure 10: Existing Roadway Network (East)

Legend
- Interstate Highway
- Arterial Road
- Collector Road
- Castle Pines City Limits

3000 1500 0 3000

ORIGINAL SCALE: 1" = 3000'

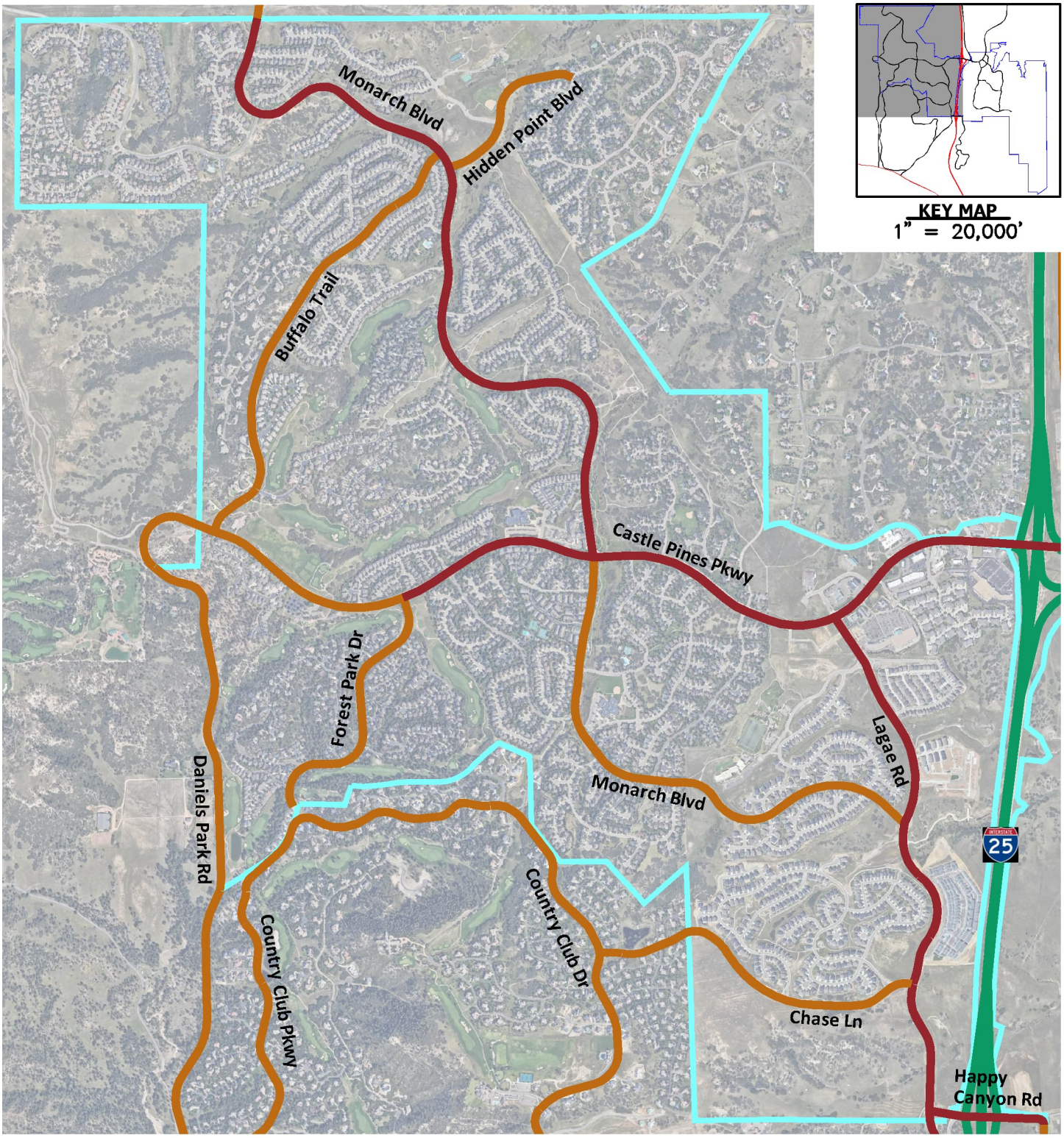


Figure 11: Planned Roadway Network (West)

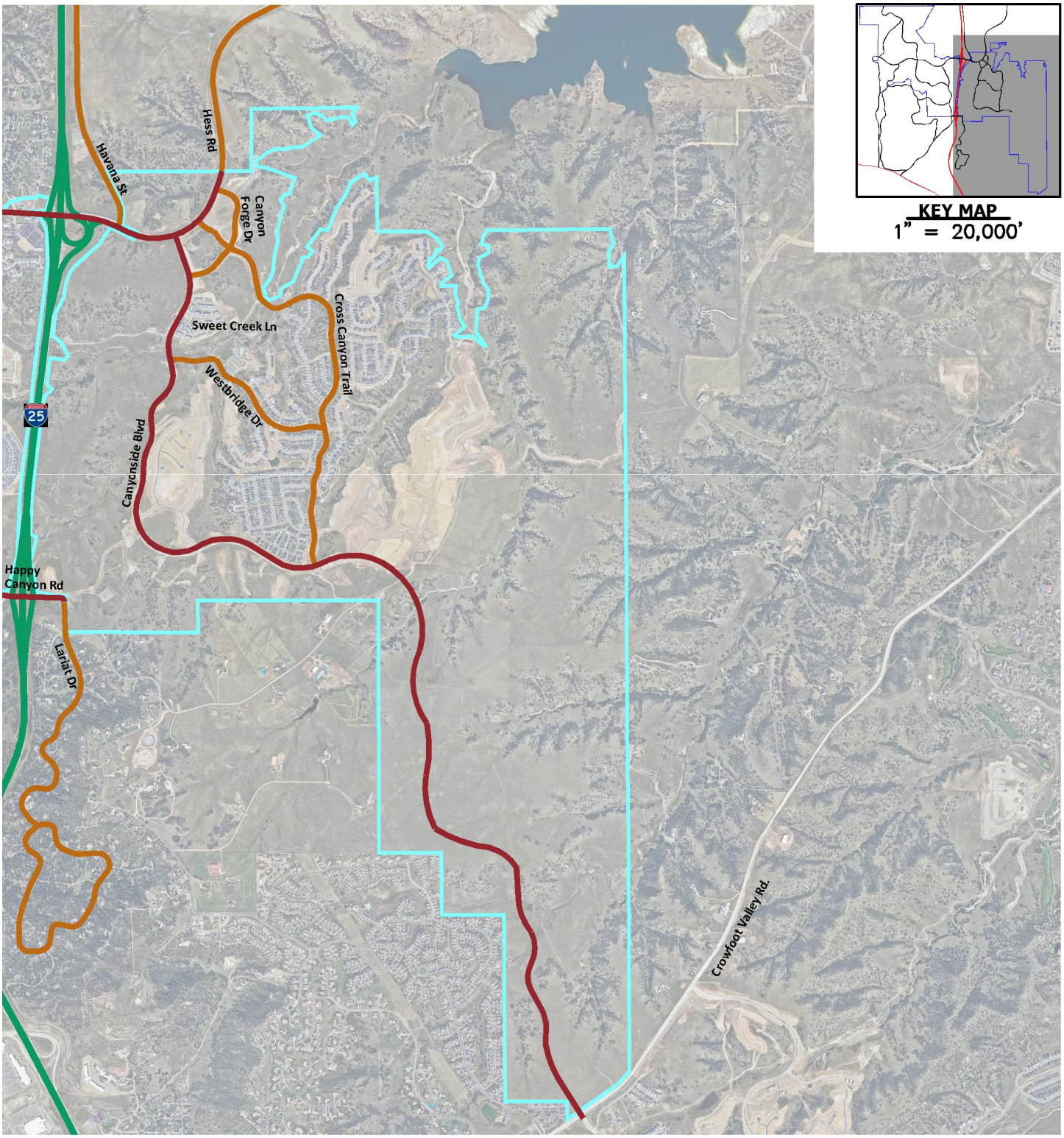


Figure 12: Planned Roadway Network (East)

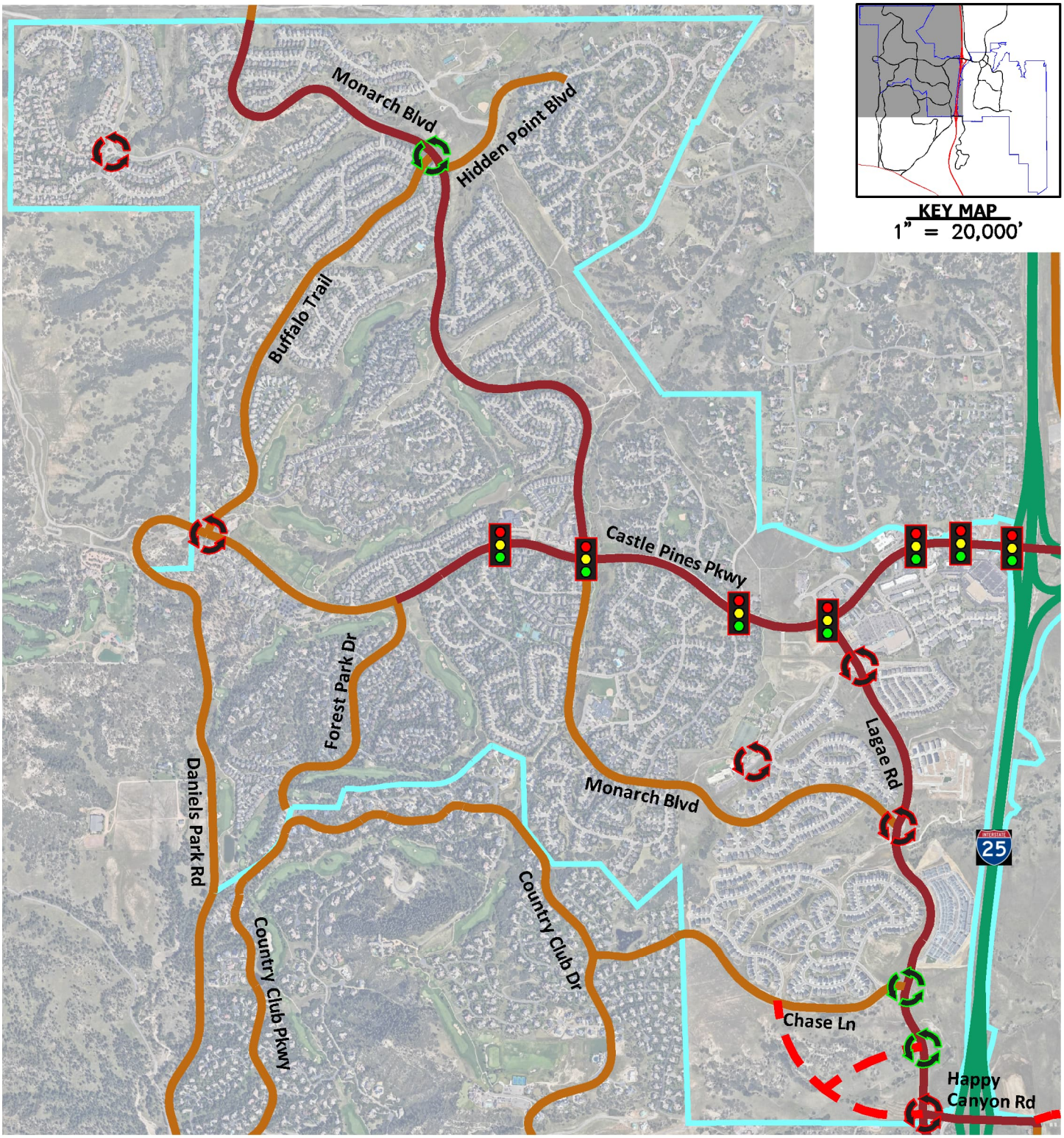


Figure 13: Intersection Control (West)

2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

Legend

Existing Traffic Control

Planned Traffic Control

Legend

Interstate Highway

Arterial Road

Collector Road

Future Buildout Roads

Castle Pines City Limits

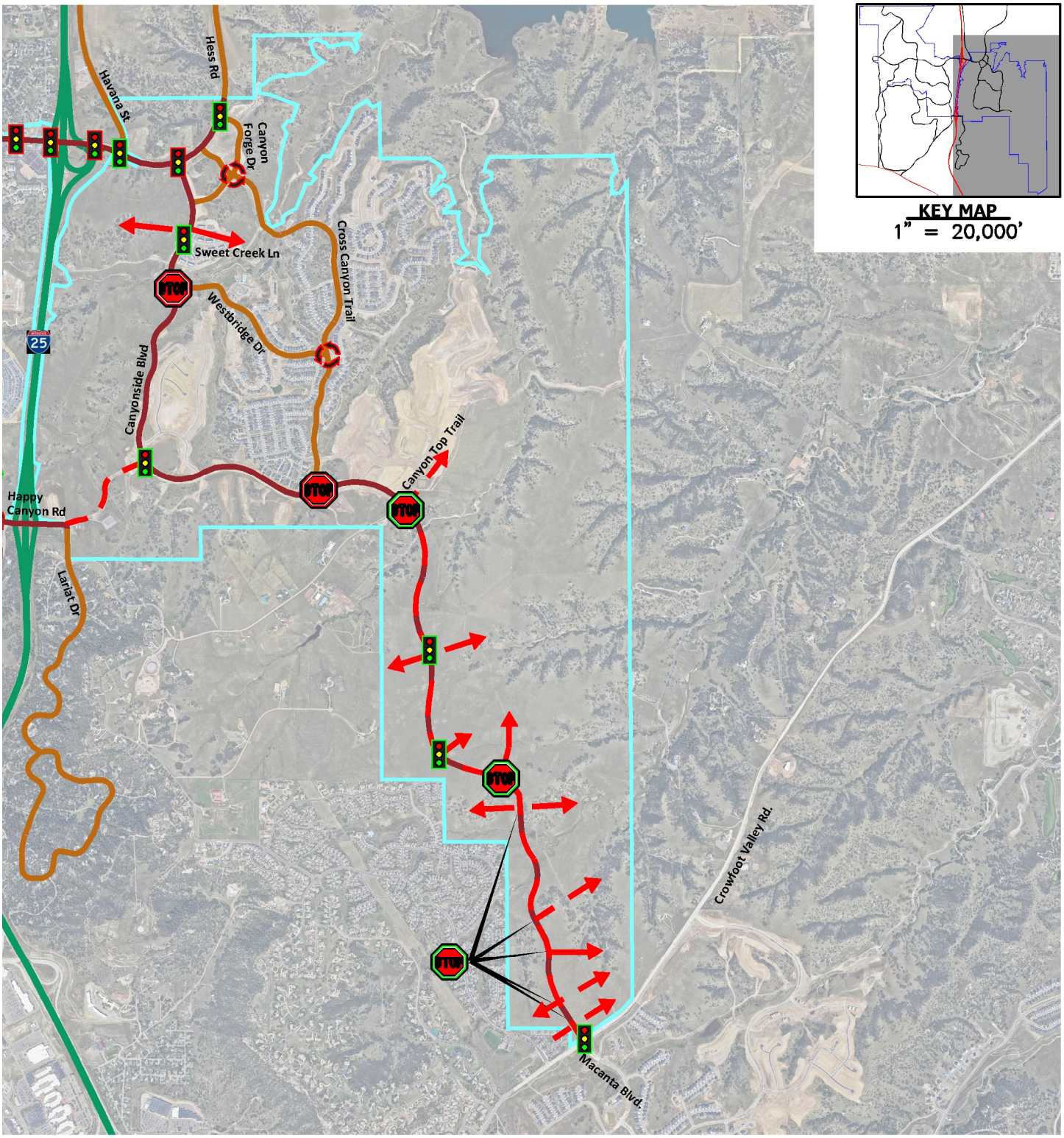


Figure 14: Intersection Control (East)

3000 1500 0 3000

ORIGINAL SCALE: 1" = 3000'

Legend

Existing Traffic Control

Planned Traffic Control

Legend

Interstate Highway

Arterial Road

Collector Road

Future Buildout Roads

Castle Pines City Limits

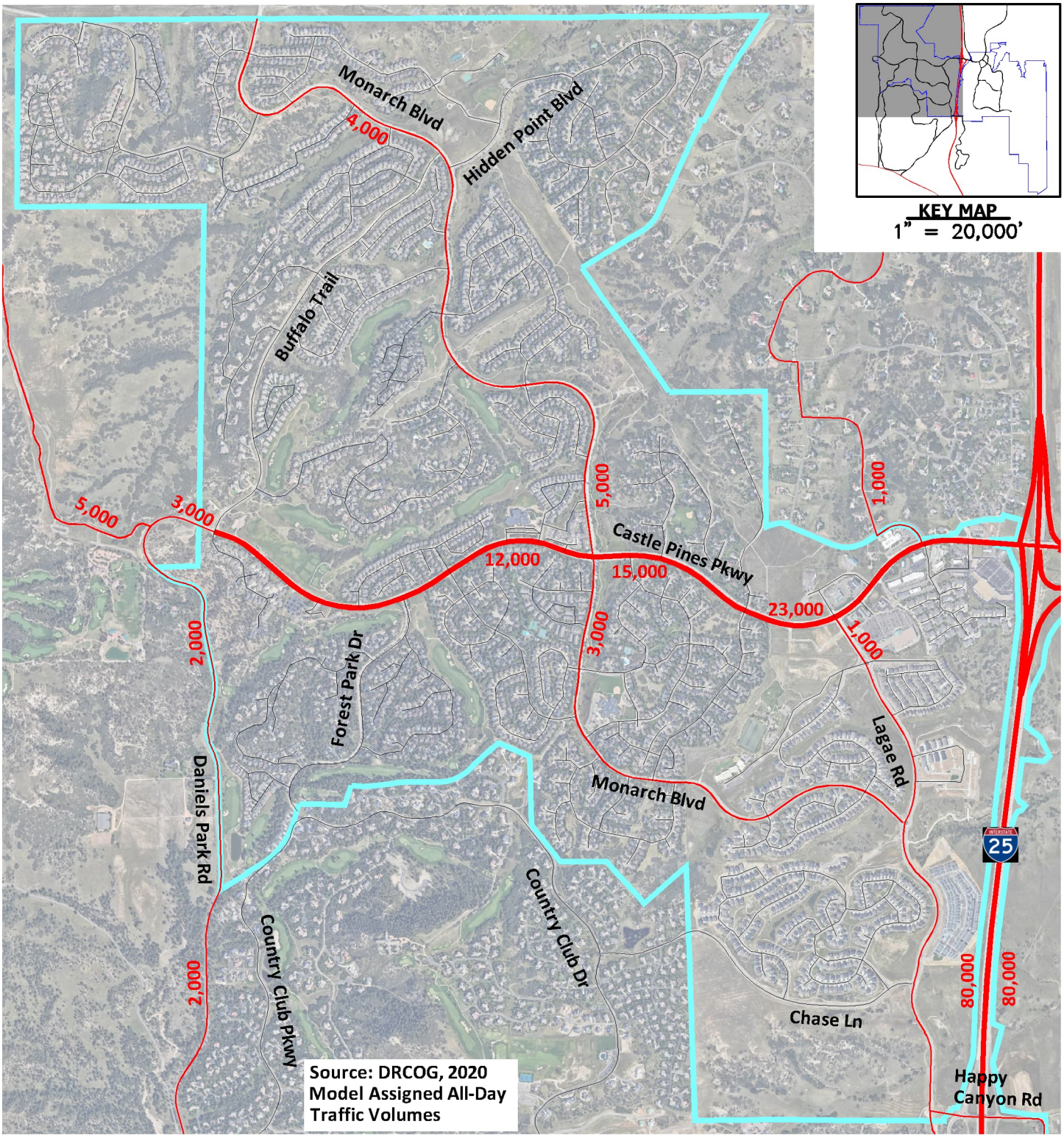


Figure 15: Average Daily Traffic, 2020 (West)

2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

Legend
- City Limits

AADT
- < 2,500
- 2,501–10,000
- > 10,000
- Castle Pines Area Roads

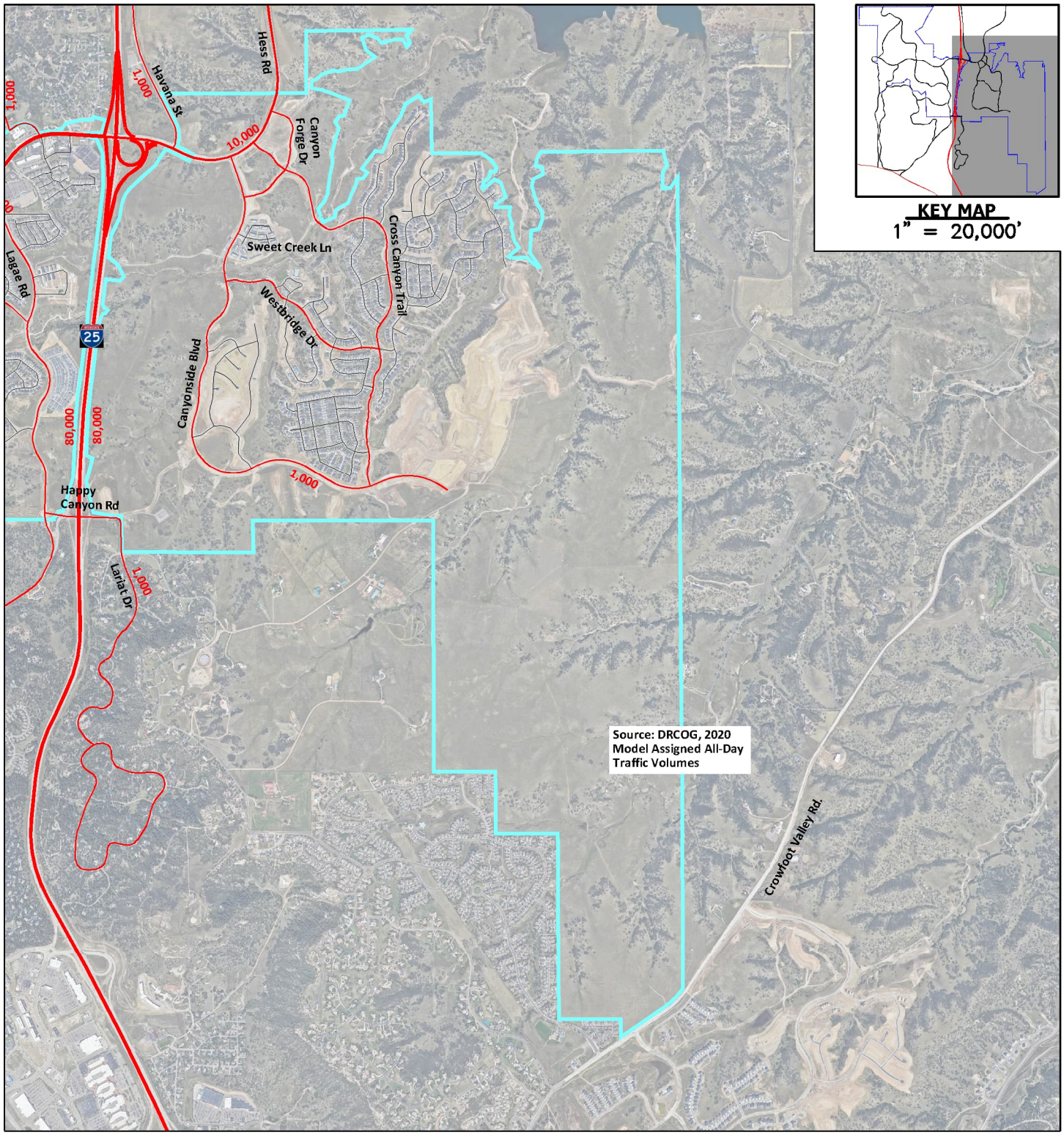


Figure 16: Average Daily Traffic, 2020 (East)

3000 3000 0 3000

ORIGINAL SCALE: 1" = 3000'

Legend
- City Limits

AADT
- < 2,500
- 2,501–10,000
- > 10,000
- Castle Pines Area Roads

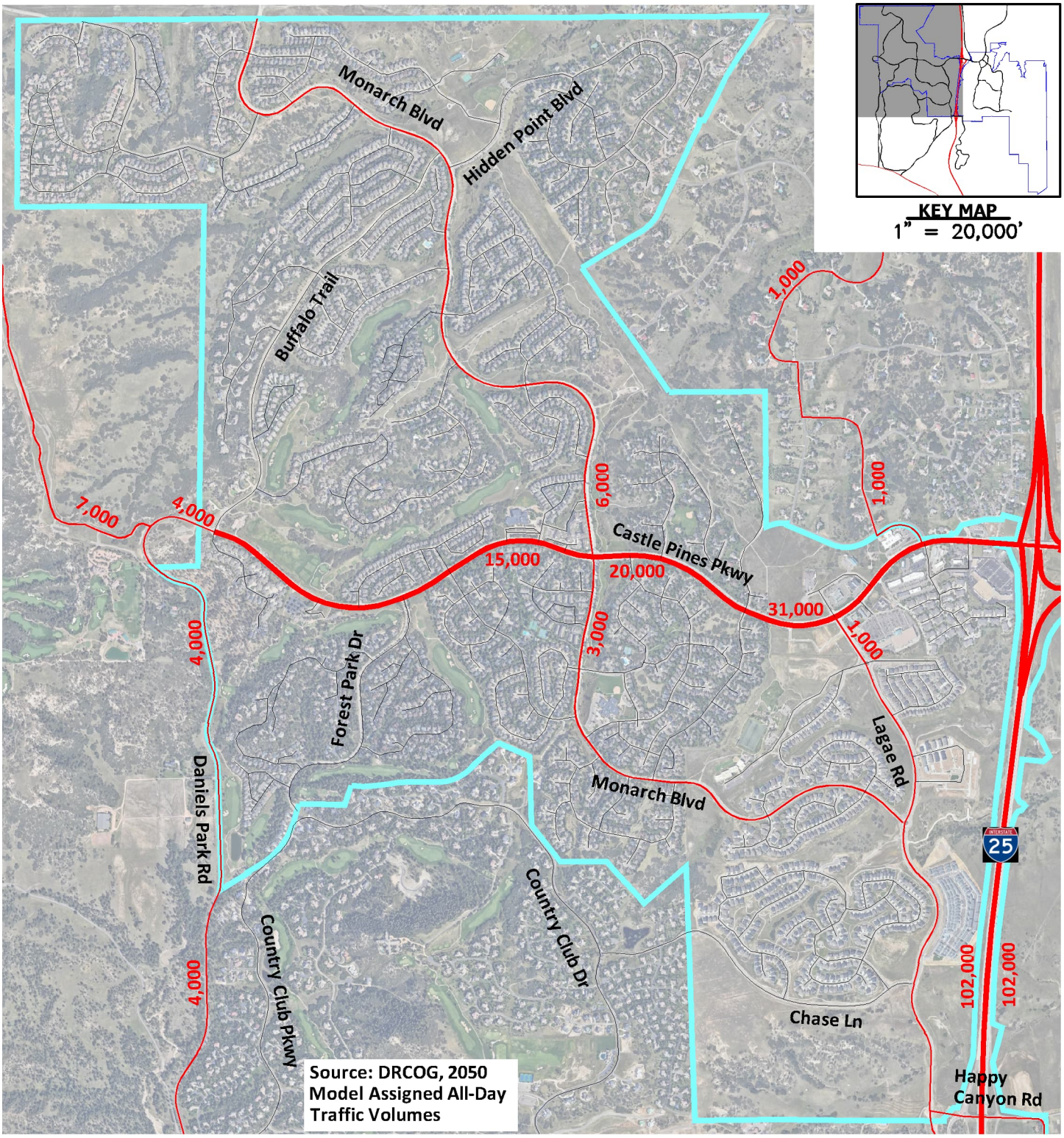


Figure 17: Average Daily Traffic, 2050 (West)

2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

Legend
- City Limits

AADT
- < 2,500
- 2,501–10,000
- > 10,000
- Castle Pines Area Roads

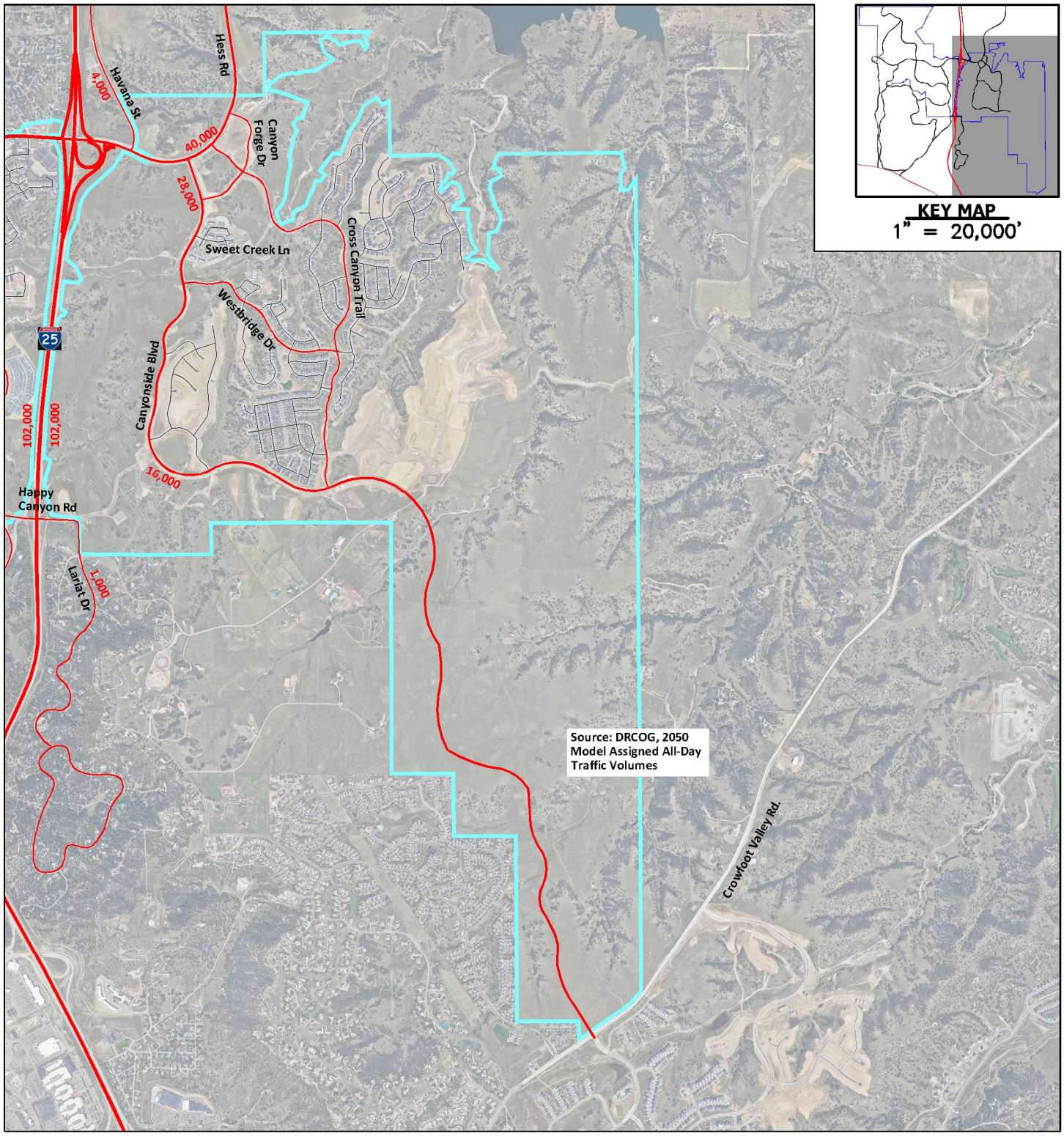


Figure 18: Average Daily Traffic, 2050 (East)

3000 1500 0 3000

ORIGINAL SCALE: 1" = 3000'

Legend
City Limits
AADT
< 2,500
2,501–10,000
> 10,000
Castle Pines Area Roads

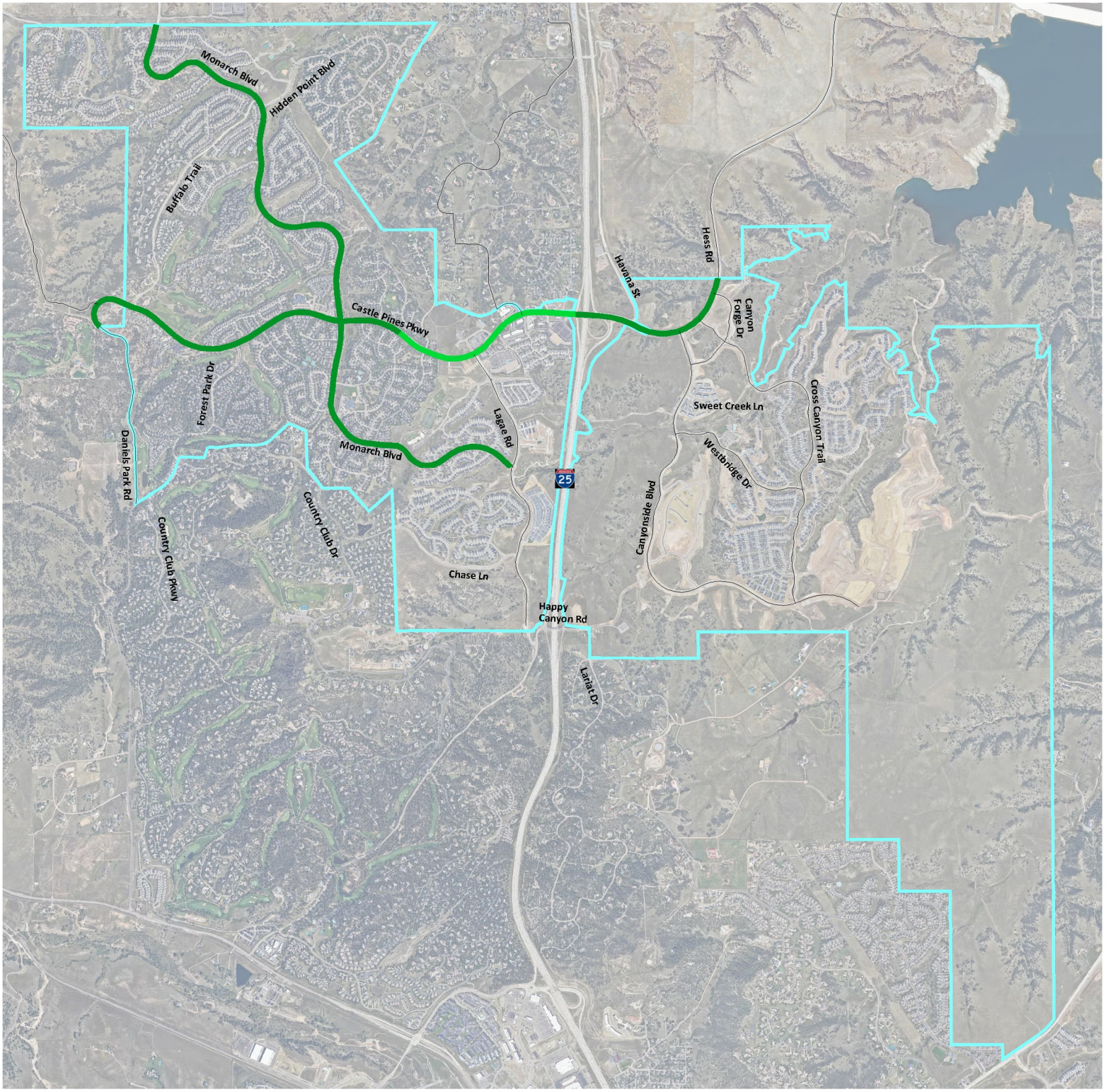


Figure 19: Level of Service, 2020

Legend
Level of Service
A
B
C
D
E
F

Legend
City Limits

3500 1750 0 3500
ORIGINAL SCALE: 1" = 3500'

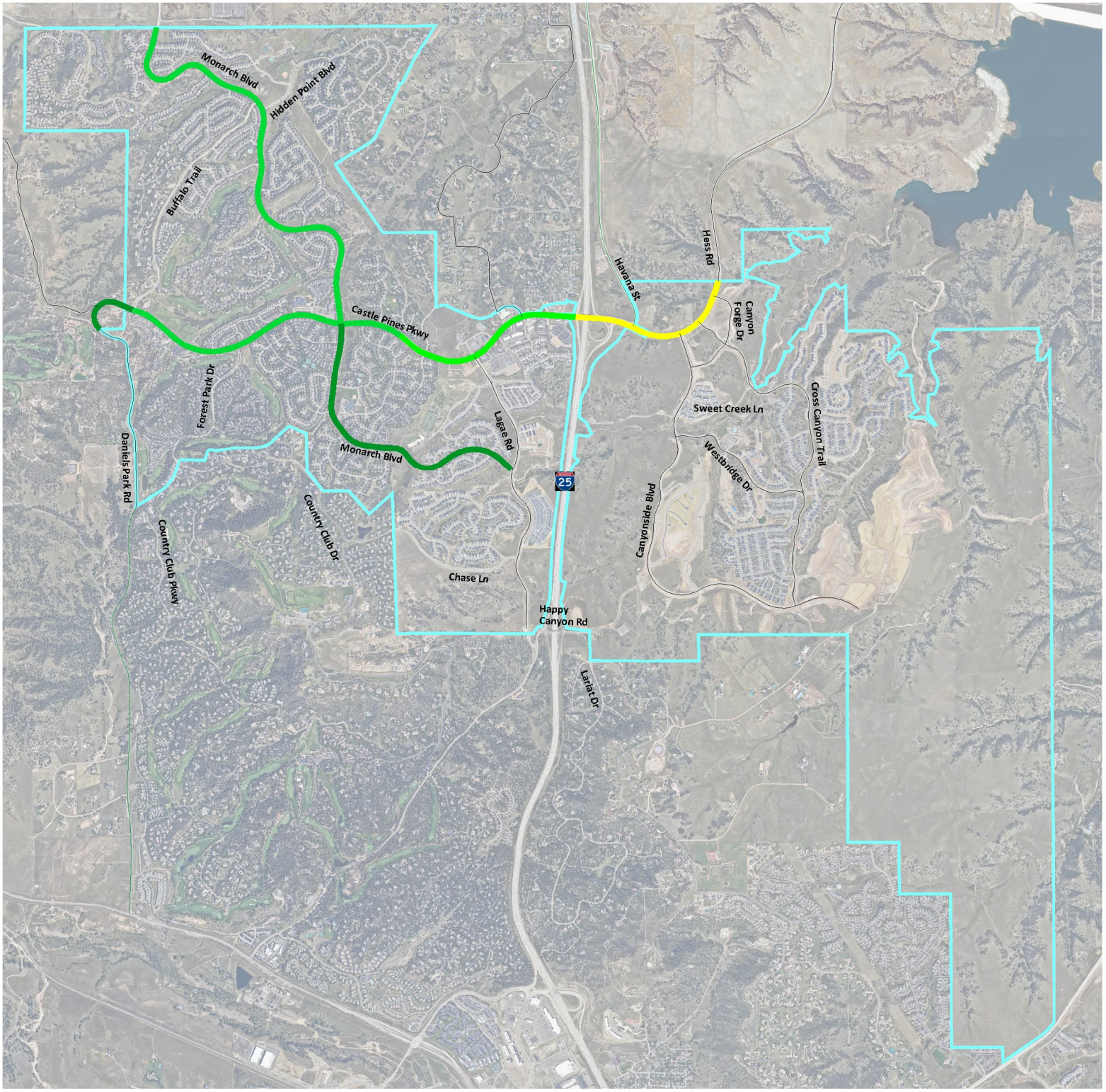


Figure 20: Level of Service, 2050

Legend
Level of Service
A
B
C
D
E
F

Legend
City Limits

3500 1750 0 3500

ORIGINAL SCALE: 1" = 3500'

On-Street Bicycle Facilities

Bicycle lanes are provided on a few roads throughout the City including Castle Pines Parkway, Monarch Boulevard, Lagae Road, and Canyonside Boulevard. These lanes are primarily used by experienced cyclists who may travel at high speeds and for long distances for commuting purposes. On-street bike lanes are not as likely to be used for low-speed recreational bike rides.

The City is continuing to expand its on-street bicycle facilities. However, limited connectivity still presents a barrier to residents wishing to complete trips by bicycle.

Crosswalk on Monarch Boulevard

Pedestrian Infrastructure

Castle Pines has sidewalks along most streets, but gaps remain in several areas. Some residential streets lack direct sidewalk connections to arterial roads, and key corridors have missing segments. Castle Pines Parkway does not have a continuous sidewalk on its south side, and Monarch Boulevard has a gap on its west side. While sidewalks exist on Castle Pines Parkway across I-25, they are not fully integrated into the pedestrian network.

The City continues to enhance pedestrian infrastructure while improving safety at multiple crosswalks. Many crossings feature push-button-activated rectangular rapid flashing beacons (RRFBs), but connectivity challenges still limit walkability. Establishing a standard for RRFBs and updating signage to align with that standard would further improve pedestrian safety and consistency.

Off-Street Trail Network

Castle Pines has an off-street trail system that includes 14 miles of trails to serve both pedestrians and cyclists. Connectivity of the trail network remains limited, however. While the trails run through residential areas of Castle Pines, they do not provide access to commercial areas of the City. Additionally, the trail network does not connect to the east side of Castle Pines across I-25. Another concern is narrow trail width. Most trails in the network are 8 feet in width, while 10-12 feet would be ideal to accommodate two-way shared use of the trails.

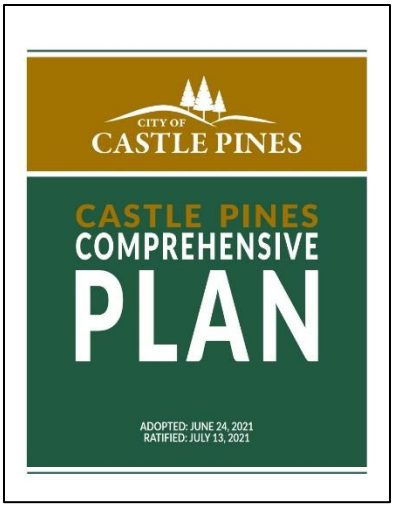
Public Transit

The nearest public transit system is provided by the Regional Transportation District (RTD), which offers light rail and bus transit at the RidgeGate Parkway Station in Lone Tree, approximately four miles north of Castle Pines. Transit services are not provided within Castle Pines, as the City is not a member of RTD. Less than 1% of residents use public transit for commuting.

Transportation Initiatives and Regional Coordination

Castle Pines Comprehensive Plan

The *Castle Pines Comprehensive Plan* was adopted on June 24, 2021 and serves as a guiding document for the continued growth and development of the City. The Comprehensive Plan was developed through a community engagement process that included stakeholder interviews, public workshops, online participation, and open house events. The public outreach effort resulted in a list of goals and objectives related to land use, community programs, and public improvements.



Community Vision

The Comprehensive Plan describes the community vision of Castle Pines in five key areas: parks, recreation, and amenities; economic development; housing; land use and growth management; and transportation. It is important to note that transportation improvements play a role in all five of these areas.

Parks, Recreation, and Amenities *that encompass new recreational facilities, a variety of park types, natural areas, high quality schools, and regional recreational amenities through an integrated city-wide network of open space, greenways, parks, and trails that are accessible to all residents of the City.*

Economic Development *that reinforces, expands, and develops our unique and connected town centers as vibrant community gathering spaces that support a range of distinct businesses and restaurants, event space, entertainment venues, mixed-use development, civic amenities, enhanced walkability, quality design and a supportive mix of housing.*

Housing *that builds on our friendly, small-town feel and provides high-quality housing for all lifecycles, integrated into great neighborhoods and set in a natural setting while providing opportunity for new types of housing in close proximity to our walkable town centers.*

Transportation *that facilitates a safe and connected community through off-street and on-street pathways, a highly connected road system, new transportation options, and unique gateway features, streetscape improvements, and signage that represents the community's high-quality aesthetic and character.*

Land Use and Growth Management *that provides a high quality-of-life community with exceptional design, augmented by extensive access to open space and physical separation from adjacent communities which together support a healthy, aesthetically pleasing, and cohesive community.*

Connection between Comprehensive Plan and Transportation Master Plan

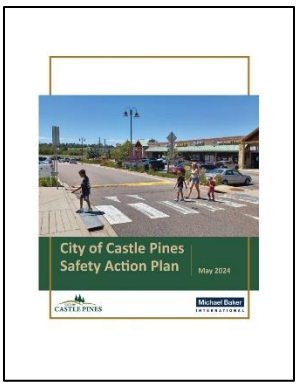
The Comprehensive Plan provides a guiding vision for the City and serves as a foundation for other planning documents such as the Transportation Master Plan. Specifically, the Comprehensive Plan describes goals and objectives, and the Transportation Master Plan provides actionable steps to achieve those priorities. Therefore, the goals and objectives of the Transportation Master Plan are based on those described in the Comprehensive Plan. This is described further in **Table 3**.

Table 3: Implementation of Comprehensive Plan Goals and Objectives

Transportation Master Plan Goal	Comprehensive Plan Goal	Implementation Measure
Goal I: Develop a safe, efficient, multi-functional transportation network designed to promote connections to local destinations.	Goal T-2: "Develop a safe, efficient, multi-functional transportation network designed to promote connections to local destinations"	Examination of network connectivity, access to local destinations, and consideration of multimodal transportation infrastructure in order to provide guidance
Goal II: Facilitate cost-effective operations and roadway maintenance strategies.	Goal T-2: "Facilitate cost-effective operations and maintenance"	Policy recommendations supporting access management; consideration of transportation system management strategies
Goal III: Develop the bicycle infrastructure network to support increased commuting trips and serve the needs of all types of cyclists.	Goal T-3: "Increase pedestrian and bicycle connectivity, accessibility, safety, and comfort"	Guidance on bicycle infrastructure design characteristics
Goal IV: Increase pedestrian connectivity, accessibility, safety, and comfort.	Goal T-3: "Increase pedestrian and bicycle connectivity, accessibility, safety, and comfort"	Guidance on sidewalks, pedestrian crossings, general connectivity
Goal V: Facilitate future opportunities for Castle Pines residents to access regional destinations via public transit.	Goal T-4: "Position the community for future public transit connections and commuting alternatives that connect to regional destinations"	Policy recommendations supporting participation in regional transit and planning initiatives
Goal VI: Develop transportation infrastructure that supports transit oriented development (TOD).	Goal T-5: "Develop transportation infrastructure that supports mixed-use development and walkable activity centers"	Policy recommendations supporting Complete Streets initiatives; roadway design guidance that supports multimodal infrastructure in mixed-use areas and locations with high levels of pedestrian activity

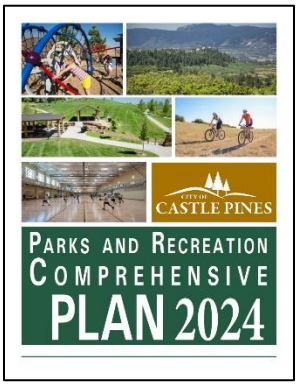
Comprehensive Safety Action Plan

The 2024 *Comprehensive Safety Action Plan* recommended strategies to improve safety for all modes of transportation in Castle Pines. The plan identified crashes in a 5-year period (2018-2022). Based on this data, recommendations included plan updates, new policies, new technology, enforcement, and infrastructure improvements. The plan sets a goal of maintaining zero roadway fatalities and working toward zero serious injuries by 2030. Projects and policies from this plan have been included in this TMP.



Parks and Recreation Comprehensive Plan

The 2024 *Castle Pines Parks and Recreation Comprehensive Plan* (PaRC Plan) outlines the City's vision for an integrated network of open space, parks, and trails that are accessible to all residents. Recreational opportunities support a healthy lifestyle among residents, in addition to being an important factor in attracting new residents and businesses to Castle Pines.



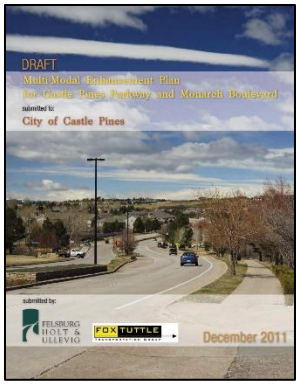
The PaRC Plan identified the need to increase access to parks and trails from existing residential areas of Castle Pines. Due to the number of cul-de-sacs and internally oriented roadways within residential neighborhoods, residents do not have easy access to nearby parks and trails. According to the PaRC Plan, this is difficult to remedy in developed areas, which is why accessibility needs to be addressed during the subdivision platting process in undeveloped areas of the City.

Trails Master Plan

The 2020 *Final Trails Master Plan* includes maps that show existing and proposed trails in Castle Pines. The proposed improvements include sidewalk connections and new crosswalks.

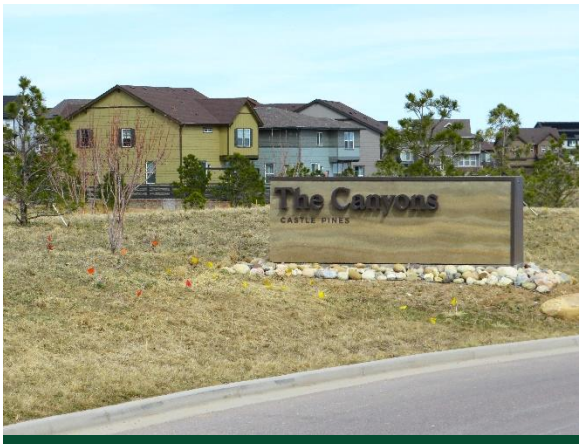
Multi-Modal Enhancement Plan

The 2011 *Multi-Modal Enhancement Plan* identifies improvements needed along Castle Pines Parkway and Monarch Boulevard to better accommodate pedestrians and cyclists. The plan outlines the need to safely accommodate all modes of transportation by managing vehicular speeds, reducing vehicle-pedestrian and vehicle-bicycle conflicts, and improving facilities for pedestrians and bicycles. The plan recommends improvements including median refuges, raised crosswalks, crosswalk signage, continuous sidewalks, and radar speed signs.



Pavement Management Program

The Castle Pines Pavement Maintenance Program involves annual improvements to the City's roadway pavement. The program aims to extend the lifespan of roadways while minimizing maintenance costs. Work includes repairing and replacing asphalt, concrete pavement, curbs and gutters, and sidewalks.



The Canyons Gateway Sign

The Canyons Planned Development

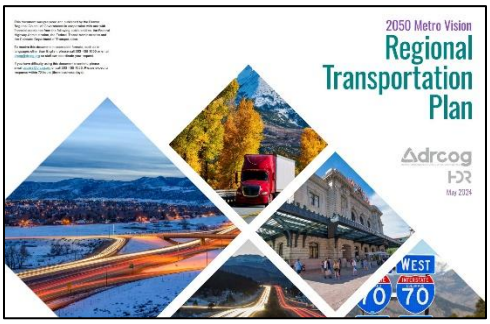
The Canyons is an ongoing planned development in Castle Pines on the east side of I-25. Upon completion, the development is expected to contain approximately 5,000 single- and multi-family homes, along with community spaces and public parks.[3] The mixed-use development is intended to give residents the opportunity to work, shop, and play within the community. Within this development, 2.1 million square feet of commercial land use is planned.

[3] "The Canyons Fact Sheet," January 2025, thecanyonsliving.com

DRCOG Metro Vision Regional Transportation Plan

The Denver Regional Council of Governments (DRCOG) is a Metropolitan Planning Organization (MPO) that collaborates with local governments across the Denver area, including Douglas County and Castle Pines. DRCOG is responsible for addressing regional planning issues related to transportation, personal mobility, growth and development, and aging and disability resources.

DRCOG produces a Metro Vision, which is a long-range plan for growth and development across the Denver metropolitan area. The Metro Vision plan was adopted in 2017 and updated in 2024. The plan discusses the goal of developing a connected multimodal transportation system that offers travel choices. It is predicted that, in the future, a higher share of travel will involve public transit, walking, bicycling, and carpooling.



The Metro Vision is supplemented by the Regional Transportation Plan, which guides the region's investments in multimodal transportation through 2050. The plan sets goals such as increasing safety for all users, improving air quality, and expanding the regional transit network.

Regional Transportation Plan Projects near Castle Pines

The Regional Transportation Plan identifies multiple improvement projects in the vicinity of Castle Pines. These improvement projects, listed in **Table 4**, include building new roads and interchanges, as well as widening existing roads.

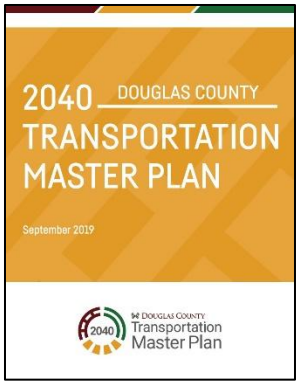
Table 4: Regional Transportation Projects near Castle Pines

Agency	Location	Description	Funding	Timeframe
CDOT	US 85: Sedalia to Daniels Park Rd	Widen from 2 to 4 lanes	Regional	2025-2029
CDOT	US 85: Daniels Park Rd to Meadows Pkwy	Widen from 2 to 4 lanes	Regional	2025-2029
CDOT and Front Range Passenger Rail	Front Range Passenger Rail	Passenger Rail along Front Range	Regional	2030-2039
Douglas County	I-25: Happy Canyon Rd	Reconstruct interchange	Regional	2025-2029
Douglas County	Castle Pines to RidgeGate RTD station	Transit corridor for light rail and microtransit study	Regional	2030-2039
Douglas County	Canyonside Blvd: Crowfoot Valley Rd to Hess Rd	New 4-lane road	Local	2030-2039
Douglas County	Crowfoot Valley Rd: Founders Pkwy to Macanta Blvd/Canyonside Blvd	Widen from 2 to 4 lanes	Local	2030-2039
Douglas County	Crowfoot Valley Rd: Macanta Blvd/Canyonside Blvd to Chambers Rd	Widen from 2 to 4 lanes	Local	2030-2039
Douglas County	Hess Rd: Canyonside Blvd to Chambers Rd	Widen from 2 to 4 lanes	Local	2030-2039

Source: 2050 Metro Vision Regional Transportation Plan, DRCOG

Douglas County Planning

The 2040 *Douglas County Transportation Master Plan*, adopted in September 2019, is a planning document that outlines the long-range vision for multi-modal transportation across the county. The plan prioritizes a transportation network that is safe, efficient, and supports the local economy.



The Douglas County plan integrates studies and plans from local municipalities. Specifically, elements of the Castle Pines Comprehensive Plan were incorporated into the Douglas County plan. This ensures consistent transportation planning efforts among county and municipal governments in the area.

Roadway System

The *Douglas County Transportation Master Plan* recommends roadway system improvements to meet anticipated travel needs. Recommended improvements include enhancements to cross street facilities to increase capacity, alternative intersections such as continuous flow or displaced left turn, and shoulder improvements for safety.

Multimodal Facilities and Services

Douglas County desires to encourage pedestrian and bicycle travel to promote a healthy lifestyle. To accomplish this, the county plans to coordinate with state and local jurisdictions to enhance existing facilities and close gaps in regional trails.

Additionally, Douglas County desires to expand transit options. This could include improvements such as extending the light rail network, expanding bus rapid transit (BRT), and adding local circulating bus routes.

Emerging Technologies

Douglas County plans to leverage emerging technologies to improve transportation and air quality. The county recommends installing automated traffic count stations along major corridors, as well as road weather information stations. Additionally, the county plans to roll out enhanced signal timing measures to improve traffic operations and to prepare for future technologies such as connected and autonomous vehicles.

Regional Transportation District

The Regional Transportation District (RTD) is a regional public transit agency serving the Denver metropolitan area. RTD is governed by a 15-member, publicly-elected board of directors and provides services across eight counties, including parts of Douglas County.[4] RTD is funded by a combination of sales-and-use tax, operating grants, and fares. The agency operates more than 170 bus routes, 10 rail lines, and more than 90 park and ride facilities. Castle Pines is not currently part of RTD, although the neighboring communities of Lone Tree and Parker are members.

Currently, RTD offers light rail and bus transit at the RidgeGate Parkway Station in Lone Tree, approximately 4 miles north of Castle Pines. The RidgeGate Parkway station was completed in 2019 as part of the FasTracks voter-approved transit initiative, which began in 2005. The station has a park and ride lot with 1,300 parking spaces.

RidgeGate Parkway Station

Another park and ride facility exists along Havana Street, 0.4 miles north of Castle Pines Parkway. This facility is owned by CDOT, but no transit services are currently offered.

[4] "About RTD," rtd-denver.com

A microtransit feasibility study is currently underway. The study is a collaborative effort between Castle Pines and Douglas County to evaluate the potential for a shuttle system connecting Castle Pines to the RidgeGate Parkway Station. This study will assess demand, operational feasibility, and funding options to determine whether microtransit can enhance mobility, reduce reliance on personal vehicles, and improve access to regional transit. If implemented, the system could provide a flexible and efficient transportation alternative for residents and commuters.

CDOT Park-and-Ride on Havana Street

Implementation

Implementing the Transportation Master Plan (TMP) will require the City to identify critical transportation challenges and determine appropriate solutions. Because infrastructure improvements must be tailored to specific locations and conditions, a uniform approach is not feasible. Each decision should align with the goals and objectives outlined in the TMP to ensure consistency with the City's long-term vision.

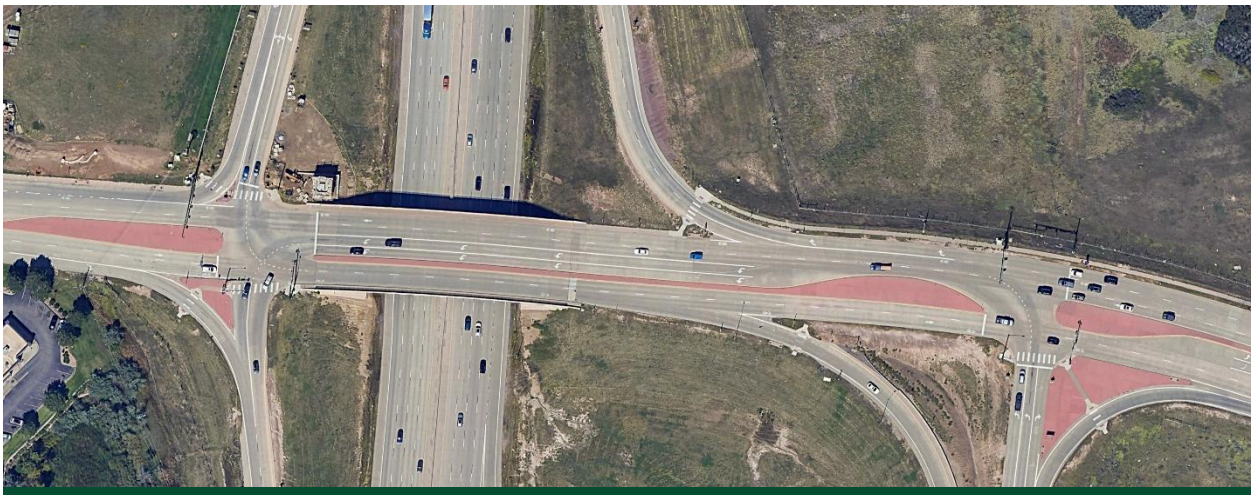
Issue Areas

The identification of potential improvements depends on the issues being addressed in any given location. To help guide the decision-making process for transportation improvements, eight main issue areas have been identified: I-25 and Castle Pines Parkway Interchange, I-25 and Happy Canyon Road Interchange, South Havana Street Realignment, Monarch Boulevard & Buffalo Trail Intersection, School Traffic Improvements, Community Character, Access and Network Connections, and Bicycle and Pedestrian Facilities.

Issue Area: I-25 and Castle Pines Parkway Interchange

Improvements are recommended for the interchange at I-25 and Castle Pines Parkway. The existing bridge over I-25 carries two through lanes in each direction, plus two westbound left turn lanes. The bridge is recommended to be widened in the future.

The *North Canyons Traffic Impact Study*, dated October 2019 by FHU, identified a need for a triple southbound left turn lane for drivers exiting southbound I-25 and heading east toward the Canyons development. To accommodate this, a third receiving lane would be required on the eastbound side of the bridge. This would require the bridge to be widened.

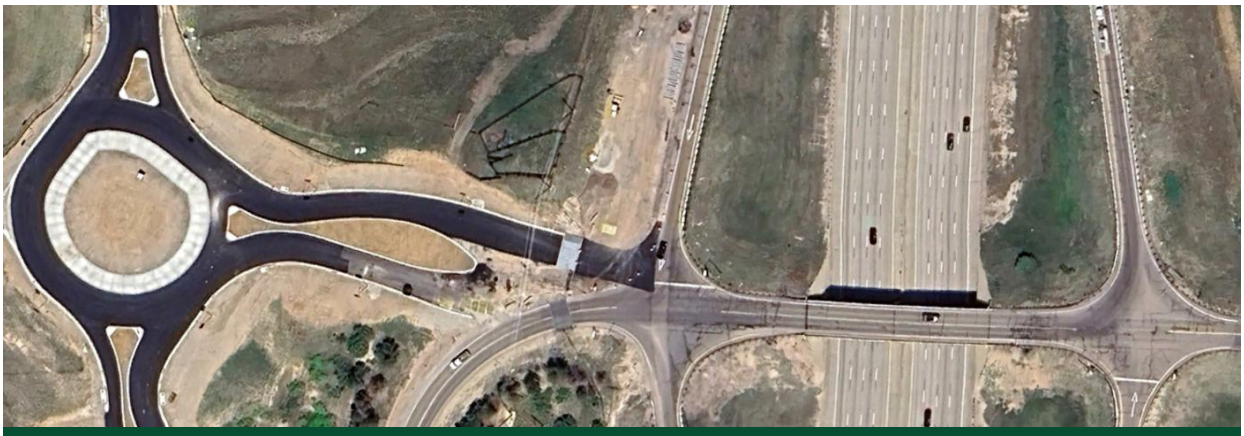


Aerial, dated 2023, of I-25 and Castle Pines Parkway

Issue Area: I-25 and Happy Canyon Road Interchange

Improvements are recommended for the interchange at I-25 and Happy Canyon Road. The existing bridge over I-25 carries one through lane in each direction, with an eastbound right turn lane at the southbound ramp.

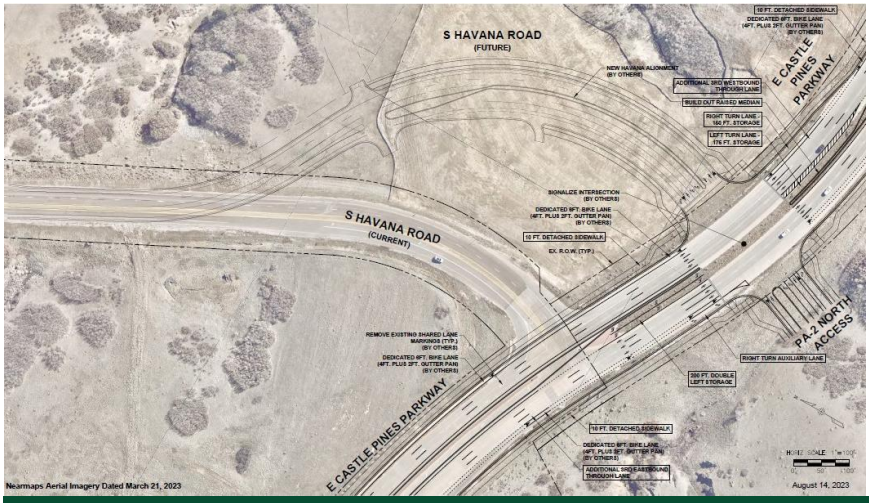
The *North Canyons Traffic Impact Study,* dated October 2019 by FHU, identified a need for a southbound left turn lane from the southbound off ramp and a channelized westbound right turn lane at the northbound ramp. It should be noted that the roundabout at Happy Canyon Road & Lagae Road has been built and is now operational.



Aerial, dated 2024, of I-25 and Happy Canyon Road

Issue Area: Havana Street Realignment

South Havana Street is currently proposed to be realigned several hundred feet to the east in order to support eastern Castle Pines' growth. In order to minimize traffic impacts, South Havana Street will remain open during the realignment.



South Havana Street Realignment Conceptual Design by FHU

The City has identified the benefits associated with this realignment to include the following: aligning the roadway with the future mixed-use network south of Castle Pines Parkway and east of I-25, improving efficiency by reducing the total number of intersections along Castle Pines Parkway, and installing a new signal at the realigned intersection to improve safety.

Issue Area: Monarch Boulevard & Buffalo Trail Intersection

The existing intersection of Monarch Boulevard & Buffalo Trail has been identified by the City as needing improvement. An intersection control analysis was performed on the intersection to determine appropriate solutions.

Roundabout at Lagae Road & Mira Vista Lane

Existing Conditions: The existing T-intersection is one-way stop-controlled. Monarch Boulevard, which runs primarily north to south, does not stop. Buffalo Trail, which serves as the west leg of the intersection, is stop-controlled.

Traffic Operations: The City has identified traffic operational issues for drivers wanting to turn left from Buffalo Trail onto northbound Monarch Boulevard. During the peak hours, drivers may have difficulty finding gaps in traffic to make the turn. This results in unacceptable delays and queuing.

Median Acceleration Lane: As an interim solution, the City may consider restriping the intersection to include a median acceleration lane for vehicles turning left from Buffalo Trail onto Monarch Boulevard. The benefit of the median acceleration lane is that it allows drivers to make the turn in two stages: 1) crossing southbound Monarch Boulevard, and 2) accelerating and merging into northbound traffic. This improvement is expected to reduce delays and queuing.

Roundabout: As an ultimate improvement to the intersection, the City may consider building a roundabout. The intersection control analysis performed at the intersection demonstrated a roundabout to be a good solution to the traffic operational concerns. Additionally, roundabouts are often safer than traditional intersections because they reduce potential conflict points and force vehicles to slow down.

Issue Area: School Traffic Improvements

Providing safe access to schools is a critical component of a well-functioning transportation system. Castle Pines contains multiple schools, and special attention must be paid to ensuring that students can safely and efficiently travel to and from school. For each school in the community, various improvement options were identified. Additionally, improvements are recommended along Monarch Boulevard, which serves as a primary route for many students.

Traffic Queues on NB Monarch Boulevard

Buffalo Ridge Elementary School is located in a residential area along Monarch Boulevard, south of Castle Pines Parkway. City and school staff have identified queuing issues during drop-off and pick-up times. A portion of students ride buses to/from school.

The following improvements are recommended at Buffalo Ridge Elementary School:

- Add missing crosswalk signage at Monarch Boulevard & Shoreham Circle
- Build a right turn lane on Monarch Boulevard to extend the drop-off/pick-up lane
- Stripe an off-site queue lane on Tenby Way
- Extend the existing drop-off/pick-up area toward Shoreham Drive
- Create a designated bus drop-off/pick-up lane on Shoreham Drive
- Clare Drive: Install all-way stop control (AWSC) signage and crosswalks at the intersections of Yorkshire Drive and Shoreham Drive
    - Advanced warning signs should be installed along Yorkshire Drive and Shoreham Drive on the approaches to the AWSC.

Figure 21: Buffalo Ridge Elementary School Improvements

American Academy is a K-8 public charter school located on Mira Vista Lane, accessible via Lagae Road. Students who walk to school can also reach American Academy from Monarch Boulevard. City and school staff have identified queuing issues during drop-off and pick-up times. Additionally, nearby residents have reported concerns about students being dropped off and picked up along residential streets, causing traffic congestion.

The following improvements are recommended at American Academy:

- Extend the striping at the U-turn area on the western end of the parking lot to accommodate three to four additional vehicles for curbside drop-off and pick-up
- Add/restripe crosswalks at the intersections of Monarch Boulevard & Murphy Creek Lane and Monarch Boulevard & Hyland Hills Street
- School to implement operational improvements for curbside drop-off and pick-up

Figure 22: American Academy Improvements

Monarch Boulevard is an important roadway for providing students with access to Buffalo Ridge Elementary School and American Academy. It has two lanes and a posted speed limit of 35 mph.

The City has identified pedestrian safety issues, particularly related to students. There are multiple marked crosswalks, including some with rectangular rapid flashing beacons (RRFB).

Monarch Boulevard is expected to be reconstructed in 2027. The following short-term improvements are recommended to be implemented before the reconstruction project:

- Restripe the drive lanes to a width of 10 feet and added buffered bike lanes
- Use higher visibility materials for crosswalks

The following long-term improvements are recommended to be implemented with the reconstruction project:

- Add bulb-outs, raised intersections, and raised crosswalks to improve pedestrian visibility
- Improve curb ramps to ensure ADA compliance
- Fill in remaining sidewalk gaps
- Provide additional lighting at crosswalks

Figure 23: Monarch Boulevard Improvements (Short-Term)

Figure 24: Monarch Boulevard Improvements (Long-Term)

Timber Trail Elementary School is located along Castle Pines Parkway, west of Monarch Boulevard. City and school staff have identified queuing issues during drop-off and pick-up times. A portion of students ride buses to/from school.

The following improvement is recommended at Timber Trail Elementary School:

- Extend the drop-off/pick-up lane by extending the dotted stripe on Castle Pines Parkway

Figure 25: Timber Trail Elementary School Improvements

DCS Montessori School is a K-8 public charter school located on the north side of Castle Pines Parkway, west of Charter Oaks Drive/Village Square Drive. City and school staff have identified queuing issues during drop-off and pick-up times. Additionally, high traffic volumes along Castle Pines Parkway present a challenge for drivers exiting the school.

The following improvements are recommended at DCS Montessori School:

- Extend the drop-off/pick-up lane by lengthening the right turn lane on Castle Pines Parkway
- Add a free-flow right turn lane onto Castle Pines Parkway to help drivers exit the school

Figure 26: DCS Montessori School Improvements

Issue Area: Community Character

Castle Pines is a growing community that seeks to develop and maintain its residential character and ensure a high quality of living for its residents. Preserving community character is an important consideration in the decision-making process for all transportation investments. In general, Castle Pines seeks transportation improvements that provide multimodal travel options while ensuring adequate roadway infrastructure for trips into and out of the community.

Castle Pines must balance the need for efficient vehicle travel with roads that also support non-motorized travel. To accomplish this, the City should consider two key principles that can reinforce community character while addressing the City's transportation goals and objectives:

- Roadway design guidance
- Community design features

Roadway design guidance ensures that roadways are constructed in a consistent manner across the City, and that all transportation infrastructure in Castle Pines takes on a uniform style. The guidance also ensures that roadways support community values, including the desire for

multimodal transportation. Importantly, roadway design guidance does not conflict with nor replace the *City of Castle Pines Roadway Design and Construction Standards*. Instead, it provides more locally-focused guidance that helps create a community-specific transportation system.

Community design features are a way of visually highlighting the distinct character of Castle Pines. Community character may be celebrated through unique signage, gateways, pavement markings, or other elements of the built environment. More information on roadway design guidance and community design features can be found in the Transportation Solutions section.

Issue Area: Access and Network Connections

The *Castle Pines Comprehensive Plan* identified limitations to the City's roadway network, including a lack of connections between off-street bicycle trails and sidewalks or bicycle lanes. Improved site access, network connections, and removing gaps in the network ensure that motorists, bicyclists, and pedestrians all have safe and efficient means of reaching their destinations. Furthermore, connections between residential areas and retail centers can have significant economic benefits.

Reclassification: The *2017 Master Transportation Plan* classified Monarch Boulevard, north of Castle Pines Parkway, as a collector. However, since this segment connects regionally to the City of Lone Tree and Highlands Ranch and transitions into Quebec Street, reclassifying it as an arterial is recommended. While the ultimate cross-section will remain two travel lanes, the reclassification will offer greater flexibility for maintenance and funding opportunities.

Issue Area: Bicycle and Pedestrian Facilities

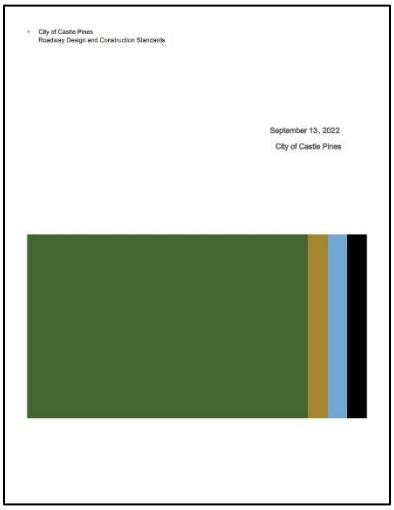
Increasing transportation options and improving infrastructure for non-motorized travel modes are major objectives for the City of Castle Pines. Castle Pines is taking a Complete Streets approach to new road construction and by utilizing roadway maintenance and reconstruction opportunities to reconfigure existing roads with infrastructure that provides safe travel options for all users. A well-rounded transportation network can support high quality of life by making it safer and easier to complete local trips without a private vehicle and consequently promoting local economic development and retail opportunities.

Transportation Solutions

Castle Pines strives to reinforce community values by maintaining a transportation network with consistent form and function. This approach requires transportation solutions that are distinct to the City and support the community's unique character.

These recommended transportation solutions focus on roadway cross-sections and roadway design features, such as signage and pavement markings. This guidance is based on Complete Streets principles, which support the City's goal of creating a connected multimodal transportation system.

Guidance for Design Standards



The City of Castle Pines *Roadway Design and Construction Standards* establish the minimum design and technical criteria for roadway infrastructure, ensuring consistency in analysis, design, and construction. Adopted in 2022, these standards apply to all developments and must align with municipal requirements and broader industry guidelines, including AASHTO, CDOT standards, and the MUTCD. While applicants may propose alternatives, they must demonstrate compliance with or exceed the established criteria. The standards cover key areas such as submittal procedures, roadway and utility design, typical roadway cross sections, access requirements, traffic impact studies, signage, traffic signals, pavement design, construction, and public infrastructure acceptance to ensure a safe, efficient, and well-maintained transportation network.

The standards should be updated on a periodic basis. This TMP provides recommendations and other guidance for future updates to the standards.

Lane Widths

Lane width affects the speed at which vehicles travel along a roadway, making this a key factor in promoting safety. Lane widths vary by classification, with narrower lanes generally found on roadways with lower classifications or where specific safety concerns exist.

Research has shown safety benefits associated with narrow lanes, with minimal decrease in roadway capacity. Narrow lanes ensure that non-motorized travel modes can safely coexist with vehicle travel by reducing vehicle speeds and providing additional space for non-motorized roadway users.

Medians

Medians separate travel lanes in opposite directions, and may provide safety benefits and improve operations by leaving space for turning vehicles. Raised or striped medians are desirable on arterial roadways, with wider medians where turn lanes are required.

Medians may also serve as pedestrian or bicycle refuges, whether as raised features or through pylons, pavement markings, and signage that distinguishes the pedestrian safe zone. Pedestrian refuges should be at least 6 feet wide. While raised medians are the safest form of pedestrian refuges, pavement markings may serve as pedestrian refuges on lower classification roadways.

Options for medians and center turn lanes include:

- Two-way left turn lane
- Raised median with intersection turn bay
- Median refuge for pedestrians and cyclists
- Median landscaping buffer

For arterial roadways, the median and center turn lane width should be 10-12 feet, plus an additional 6-foot pedestrian refuge at intersections. Pedestrian refuges are most critical where there are two or more travel lanes in each direction.

Bicycle Infrastructure

Bicycle lanes should be a minimum of 5 feet wide and, where feasible, should be included on all roadways classified as collectors and above. Green paint can be utilized to better designate the bike lane. Green paint is currently in place along Castle Pines Parkway.

Bike Lane and Bike Buffer along Castle Pines Parkway

Bicycle buffers provide additional space between a bicycle lane and the outside edge of a vehicle travel lane. Buffers are most appropriate on higher speed roadways (e.g. 35 MPH and above), including principal arterials.

Bicycle boulevards are an increasingly common method of providing bicycle infrastructure on low volume roadways. These facilities are shared between bicycles and vehicles and contain distinct pavement markings and signage that designate the route as appropriate for cyclists. Bicycle boulevards generally feature low speed limits and encourage cyclists to travel with the flow of traffic, as there is no separation between vehicles and bicycles.

Multi-use paths are an alternative for on-street bicycle facilities, particularly along higher speed roadways. Since multi-use paths appeal to less confident cyclists and recreational users, they may also be desirable alongside on-street facilities, which are generally preferred by more experienced riders.

E-bikes: The transportation industry is undergoing a significant shift toward electrification, with electric bikes (e-bikes) experiencing rapid growth. As e-bike usage increases, it is essential to design bikeways that accommodate a variety of devices, speeds, and rider types while maintaining safety for users of all ages and abilities. Whether upgrading existing infrastructure or planning new facilities, careful consideration must be given to how e-bikes fit into the network. Key design factors include bikeway design speed, posted speed limits, and appropriate bikeway width. Other design factors include minimizing speed differentials, addressing elevation changes, and providing adequate queueing space, protected corner design, smooth horizontal tapers, and stopping sight distance. Thoughtful integration of these elements ensures that bikeways remain safe and efficient for all users.

E-scooters: Along with e-bikes, electric scooters (e-scooters) are experiencing significant growth in popularity. E-scooters present a challenge as a new vehicle type with few existing regulatory standards. Generally, e-scooters are treated similarly to e-bikes, as both are expected to use bikeways rather than sidewalks. Therefore, many of the same design considerations apply.

Pedestrian Infrastructure

Sidewalks have a standard width of 5 feet, although a width of 6 feet is desirable along principal arterials because of the higher vehicle speeds. All sidewalks must be ADA compliant. Wider sidewalks, including widths of up to 10 feet, are desirable in mixed-use and town center areas where higher levels of pedestrian activity are expected.

Pedestrian and landscape buffers are the space between the sidewalk edge and the curb that may include landscaping, utilities, signage, and public amenities such as benches and bicycle racks. All roadways should provide a buffer between the sidewalk edge and the curb if right-of-way permits. Wider buffers are preferred on higher speed roadways.

Median pedestrian refuges are desirable on major arterials, particularly in mixed-use and retail areas. Pedestrian refuges should be 6 feet or more in width.

Crossings and Intersection Spacing

Intersection spacing is a key factor in the efficiency of a roadway network. The most efficient networks include parallel roads with frequent intersections (e.g. arterial roadways with half-mile spacing or less). Closely spaced intersections are also beneficial to pedestrians and cyclists, as they provide more crossing opportunities. Although a dense transportation network may not be appropriate in all areas of Castle Pines, some elements of walkable urban communities should be applied in order to support multimodal transportation.

Pedestrian crossings should be considered every quarter to half mile. In locations with higher levels of pedestrian activity, such as near schools or retail centers, pedestrian crossings should be considered at least every quarter mile.

Other Considerations

Limited Right-of-Way

The allocation of right-of-way space, along with the size and scale of roadways, reflects the values of the community. For instance, narrower lanes can promote slower speeds, improving road safety and functionality while enhancing the City's residential character. These features help reinforce Castle Pines as a family-friendly community by discouraging through traffic and offering safe infrastructure for both pedestrians and cyclists. Additionally, the types of infrastructure provided play a key role in supporting local values, such as safe on-street bike lanes and a connected trail network.

Restricted right-of-way, however, may present challenges in the application of roadway design standards. This is especially true for projects involving the restriping or reconstruction of existing roadways. Instances where right-of-way is limited may require the prioritization of space for the most critical roadway elements. It is desirable to meet design standards, but it may not be possible in all cases.

Access and Connectivity

A well-connected roadway network has the ability to reduce vehicle miles traveled and improve emergency response times. To achieve this, major roadways must be well connected with residential areas, local businesses, and parks.

Residential Cul-de-sac in Castle Pines

The existing roadway network in Castle Pines struggles with limited connectivity and numerous cul-de-sacs. Although this layout supports the City's residential character, it is an impediment to creating a multimodal transportation system. To correct this, the City may choose to limit the number of cul-de-sacs in new developments. Additionally, the City can improve pedestrian and bicycle connectivity by providing non-motorized neighborhood access points and more frequent crosswalks.

Castle Pines can address the travel needs of motorists through access control measures, which improve traffic flow by limiting the frequency of driveways and reducing the number of turning movements. The City can also ensure large-scale network connectivity through the layout of future roadways. Traffic signals should be provided at major intersections, generally every half mile along arterial roadways.

Curb Return Radii

Intersection curb return radii affect the speed at which vehicles complete intersection turning movements, as well as the distances that pedestrians must travel to cross intersections. Large curb radii ease turning for large vehicles, but create longer distances for pedestrians. According to the National Association of City Transportation Officials (NACTO), "In urban settings, smaller corner radii are preferred and actual corner radii exceeding 15 feet should be the exception."[5]

Community-Specific Design Elements

Community-specific roadway design refers to the implementation of roadway design elements that reinforce the community's identity. These elements may include signage, visual markers, and landscaping that are unique to Castle Pines. The goal of community-specific design is to let people know they are in Castle Pines.

Community-specific design elements may include:

- Pavement markings
- Unique signage
- Crosswalk design features
- Community gateways
- Landscaping in public right-of-way

Pavement Marking

Pavement markings are a form of communication to road users. Along with signs and signals, pavement markings inform drivers where to position their vehicles, warn about upcoming conditions, and indicate where passing is allowed. They can also be used to add character to a roadway by applying unique colors and shapes to reinforce the community's identity. Community-specific pavement markings can also be used on multiuse trails throughout the City.

Crosswalk Design

A well-designed crosswalk calls attention to drivers in order to prevent conflicts. Typical crosswalk design elements include pavement markings, signage, and lighting. Other safety improvements can include RRFBs and raised pavement. Castle Pines could implement unique crosswalk design elements to support the City's identity.

Sidewalk Design

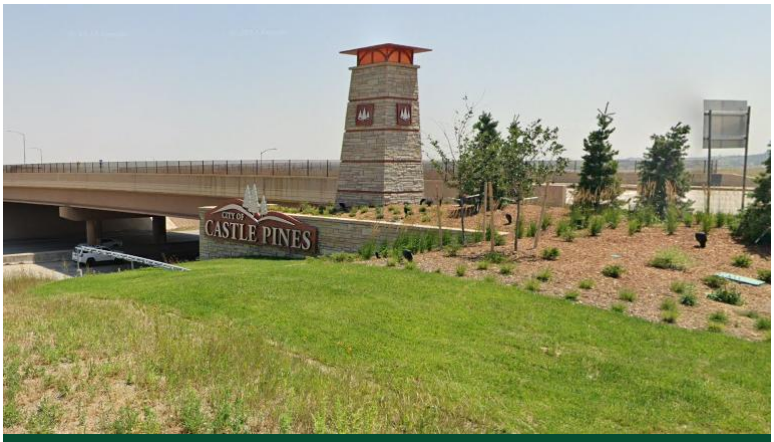
The design of sidewalks can add character to a corridor. Sidewalks can be constructed with a variety of materials such as brick, tile, stone, or concrete. They may also have unique patterns,

[5] "Urban Street Design Guide," NACTO

colors, or inlayed signage for either aesthetic or practical purposes. Plus, the use of permeable materials for sidewalks may help reduce water runoff.

Gateway Design

Gateways include unique signage and public artwork that serve as a significant point of entry into the community. The City adopted a gateway design plan in August 2019 that includes concept renderings.



Gateway at I-25 and Castle Pines Parkway

Wayfinding and Signage

Unique wayfinding signage is a simple way of indicating presence in the community. Designs can reflect local arts and culture, and can serve the dual purpose of navigating visitors and residents, while creating a sense of place.

Signage can also be used for the benefit of pedestrians and cyclists. While most roadway signage is designed for motorists, signage oriented toward pedestrians and cyclists can help support the City's desire for a multimodal transportation system.

Funding

The City of Castle Pines can utilize its Capital Improvement Program (CIP) budget to fund transportation projects. The CIP budget allocates resources for roadway expansions, intersection improvements, multimodal infrastructure, and safety enhancements based on long-term planning priorities. Other potential funding sources include the following:

- **State and Regional Grants**: Funding opportunities through CDOT, DRCOG, and other agencies for infrastructure improvements.
- **Tax Revenues**: Sales tax, property tax, or dedicated transportation taxes that support roadway and transit projects.
- **Special Improvement or Metropolitan Districts**: Localized funding mechanisms where property owners contribute to area-specific infrastructure improvements.
- **Bond Financing**: Issuing municipal bonds to fund large-scale transportation projects with long-term repayment.

The City has access to approximately 400 state and federal grant programs[6] that can help fund critical transportation and infrastructure projects. These grants provide opportunities to improve roadway safety, multimodal connectivity, transit options, and sustainability initiatives while reducing the financial burden on local resources. By leveraging federal funding, the City can invest in transportation improvements, smart infrastructure, pedestrian and bicycle facilities, and environmental resilience projects, ensuring long-term growth and mobility enhancements for the community.

The City can also continue to leverage private developers to help build and expand the transportation network by integrating infrastructure requirements into the development approval process. This can be achieved through the following:

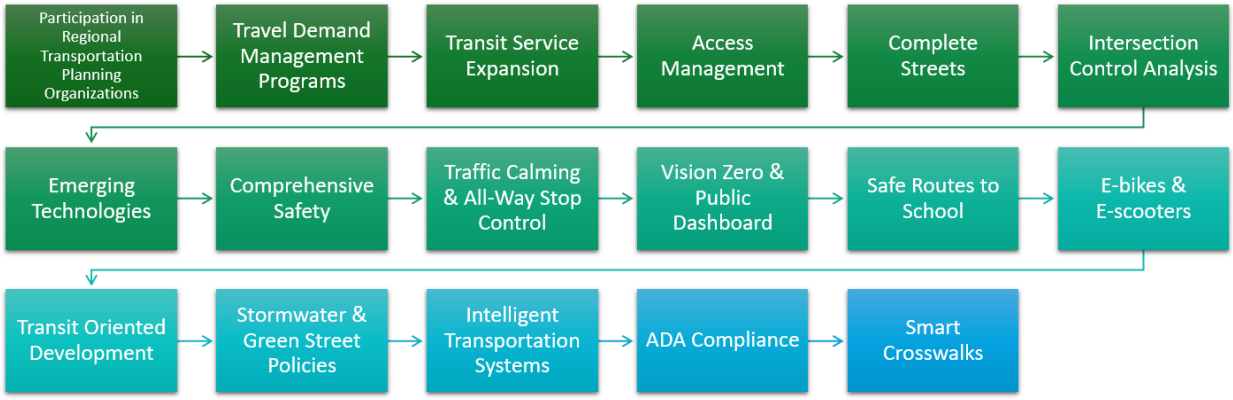
- **Development Agreements:** Requiring developers to fund or construct roadway improvements, sidewalks, bike lanes, and transit facilities as part of new developments.
- **Impact Fees**: Implementing transportation impact fees to ensure new developments contribute to roadway and mobility improvements.
- **Public-Private Partnerships (P3s)**: Partnering with developers to co-fund and build key transportation projects that benefit both the community and private development.
- **Right-of-Way Dedications**: Ensuring developments dedicate necessary land for roadways, trails, and multimodal infrastructure.

By proactively engaging developers in the planning and funding process, the City can expand its transportation network efficiently while aligning growth with long-term mobility goals.

[6] The 400 is based on data in 2024. The City may not be eligible for all federal grants.

Policy Options

Castle Pines faces a number of transportation challenges including congested roadways, limited connectivity, and a lack of transit options. The City should develop new policies to solve these issues. These recommended policy options include participation in regional planning agencies, access management, and making use of new technologies.



Participation in Regional Transportation Planning Organizations

In 2017, the City of Castle Pines became a member of DRCOG, which performs a range of planning activities including population, employment, and travel projections; establishing a vision for growth in the region; collecting transportation data; and determining long-range regional transportation strategies.[7] DRCOG is also responsible for the programming of federal transportation funds available to the Denver metropolitan area. Participation in DRCOG gives Castle Pines the opportunity to influence regional decision-making, including the selection of projects for federal funding.

Travel Demand Management Programs

Transportation Demand Management (TDM) programs improve transportation system efficiency by reducing single-occupancy vehicle trips, encouraging off-peak travel, and shortening trip times. Traditionally, TDM focused on commuters, promoting transit use, carpooling, vanpooling, biking, walking, and telework. However, modern TDM strategies apply to all travelers and incorporate intelligent transportation systems (ITS), congestion pricing, and parking management to influence demand. By enhancing accessibility, reliability, and modal diversity, these measures encourage greater use of transit and ridesharing, ultimately reducing congestion and improving system performance.

[7] "About DRCOG," drcog.org

Transit Service Expansion

Expanding transit service in Castle Pines is an important step in reaching the City's goal of creating a connected multimodal transportation network. Currently, transit services are not available in the City.

Castle Pines may consider membership in the Regional Transportation District (RTD), which operates transit services across the Denver metropolitan area. Services provided by RTD may include local bus routes and shuttle service to the RidgeGate Parkway light rail station. RTD can also offer Call-n-Ride personalized bus service and Access-a-Ride service for people with disabilities.

Access Management

An Access Management Plan for Castle Pines Parkway would enhance safety, traffic flow, and multimodal connectivity by consolidating driveways, establishing a permit process for new access points, and implementing spacing standards to reduce conflict points. The plan would promote shared access, turn restrictions, and signalized entry points while reallocating space for bike lanes, sidewalks, and landscaping. It would align with land use planning to ensure coordinated development, requiring traffic impact studies where necessary. By creating clear guidelines for access modifications and long-term roadway improvements, the plan would minimize disruptions and support a safer, more efficient transportation network.

Complete Streets

The roadway design guidance within the Transportation Master Plan could be further supported by the adoption of a formal Complete Streets policy. Complete Streets is an approach to roadway design that accommodates all users, including motorists, bicyclists, pedestrians, and transit. A Complete Streets policy would also support many of the goals and objectives of the Transportation Master Plan. Benefits include safer connections to schools, strengthening of existing design practices, and establishing Castle Pines as a community that prioritizes multimodal transportation. Additionally, a Complete Streets policy would give the City a platform with which to require private developments to incorporate more opportunities for active transportation.

Traffic Signal at Castle Pines Parkway & Lagae Road

Intersection Control Analysis

An Intersection Control Analysis (ICA) policy would ensure that the most effective and safest intersection design is selected during conceptual planning. Given that roundabouts can reduce

the severity of vehicular accidents, an ICA should be conducted for all intersections where traffic signals are proposed. This analysis would compare roundabouts and signalized intersections through a structured 5-step process: identifying project needs, reviewing feasibility, conducting operational analysis, performing a benefit/cost evaluation, and selecting the preferred alternative. Implementing this policy would promote safer, more efficient intersections while optimizing long-term transportation investments.

Emerging Technologies

Castle Pines can leverage emerging technologies to improve the safety and efficiency of its transportation system. Similar to the strategies discussed in the *Douglas County Transportation Master Plan*, the City may implement enhanced signal timing measures to improve traffic operations and prepare for future technologies including connected and autonomous vehicles.

Comprehensive Safety

The *Comprehensive Safety Action Plan* recommended several policies to enhance roadway safety, which have been carried over into this TMP. These policies focus on infrastructure improvements, enforcement, education, and maintenance to create a safer transportation network. Key initiatives include the following:

RRFB at Monarch Boulevard & Shoreham Circle

- Standardizing Rectangular Rapid Flashing Beacons (RRFBs) and updating signage to improve pedestrian safety.
- Conducting speed studies and implementing traffic calming measures, such as speed feedback signs, in coordination with law enforcement.
- Educational campaigns targeting young and elderly residents on modern traffic conditions, including proper use of roundabouts.
- Traffic signal enhancements, such as restricting right turns on red, adding dedicated pedestrian phases, and adjusting left-turn controls to reduce conflicts.
- Maintenance and construction improvements, including more frequent street sweeping, enhanced pavement striping, evaluating frequency of restriping, and stricter oversight of traffic control plans.

Traffic Calming and All-Way Stop Control

A Traffic Calming and All-Way Stop Control (AWSC) Policy would ensure that traffic calming measures are implemented based on engineering studies rather than public requests alone. The

City should evaluate traffic calming options through a data-driven approach, selecting appropriate improvements to address speeding concerns while ensuring compliance with the Manual on Uniform Traffic Control Devices (MUTCD) for AWSC implementation. AWSC should not be used solely for traffic calming but may be appropriate at intersections of residential collector streets with similar design and operational characteristics. In Castle Pines, AWSC could be strategically placed to enhance pedestrian safety, particularly for students walking to and from school.

Vision Zero and Public Dashboard

A Vision Zero Policy for Castle Pines would build upon the City's 2024 Comprehensive Safety Action Plan. The policy would prioritize eliminating traffic fatalities and severe injuries by implementing data-driven safety strategies. Establishing clear goals and tracking progress through an online public dashboard would enhance transparency and community engagement. By continuously refining safety measures, the City can create a safer, more equitable transportation system for all users.

Safe Routes to School

A Safe Routes to School (SRTS) policy would promote safer walking and biking conditions for students by implementing infrastructure improvements such as crosswalks, speed limits, and bike lanes. To ensure these routes remain effective and adapt to evolving transportation needs, the City should periodically conduct SRTS studies for both public and charter schools. These studies would identify opportunities for enhanced pedestrian and cyclist safety. This type of policy would support long-term investments in school-area infrastructure while fostering a safer, more accessible environment for students traveling to and from school.

E-bikes and E-scooters

Electric bikes (e-bikes) and electric scooters (e-scooters) present new opportunities for the City to enhance mobility options, reduce environmental impacts of the transportation network, and promote equitable transportation. To integrate e-bikes and e-scooters into transportation planning efforts, the City should explicitly address them within their planning documents. Examples of how to do this include the following:

Active Transportation Plans: Designate safe and accessible facilities, such as dedicated bike lanes and mixed-use trails with capacity to accommodate higher speeds and diverse users that come with e-bike/scooter adoption. Identify parking needs for bikes/scooters and unique considerations to parking facilities that meet the needs of users.

Electrification Plans: Implement e-bike/scooter-specific policies that emphasize charging infrastructure in key locations, provide subsidies for low-income residents, and foster partnerships with e-bike/scooter manufacturers and advocacy groups to encourage widespread adoption.

Curbside Action and Management Plans: Prioritize e-bike/scooter parking zones and loading areas in spatially restrained areas that are experiencing an increased demand for use.

Transit Oriented Development

A Transit-Oriented Development (TOD) policy would promote high-density, mixed-use development near transit hubs to enhance walkability and reduce dependence on cars. By integrating residential, commercial, and recreational spaces within close proximity to public transit, TOD could foster a more sustainable and accessible community. Implementing TOD in Castle Pines could support future transit expansion, improve mobility options, and create vibrant, pedestrian-friendly neighborhoods that align with long-term growth and environmental goals.

Stormwater and Green Street Policies

A Stormwater and Green Streets policy would incorporate permeable pavement, bioswales, rain gardens, underground water quality vaults, and other green infrastructure to effectively manage stormwater runoff and reduce flooding. By integrating these sustainable design elements into roadways and public spaces, the City can improve water quality, mitigate urban heat effects, and enhance the overall streetscape. Implementing Green Streets in Castle Pines would support long-term environmental resilience, promote sustainable development, and create aesthetically pleasing, functional public spaces that benefit both residents and the natural ecosystem.

Intelligent Transportation Systems

An Intelligent Transportation Systems (ITS) policy would leverage artificial intelligence (AI), real-time data, and adaptive signal control technology to optimize traffic signal timing, reduce congestion, and enhance overall traffic flow. By integrating ITS into Castle Pines' transportation network, the City can improve travel efficiency, enhance roadway safety, and support emerging technologies like connected and autonomous vehicles. Implementing ITS solutions, such as smart traffic signals, real-time traveler information systems, dynamic speed limits, and data-driven traffic management, would create a more responsive and efficient transportation system that adapts to changing conditions and supports long-term mobility goals.

ADA Compliance

An ADA Compliance policy would ensure that sidewalks, transit stops, intersections, and public spaces in Castle Pines are fully accessible to all individuals, including those with disabilities. By adhering to the Americans with Disabilities Act (ADA) standards, the City can improve mobility, safety, and inclusivity through infrastructure enhancements such as curb ramps, detectable warning surfaces, wider sidewalks, and accessible pedestrian signals. Regular assessments and upgrades to public facilities would help eliminate barriers, promote equitable access, and create a more inclusive transportation network for all residents and visitors.

Smart Crosswalks

Smart crosswalks enhance pedestrian safety using sensors, flashing beacons, and overhead signage to improve visibility, especially during snowstorms. Pedestrian detection systems, including infrared, radar, and thermal cameras, activate warning lights or adjust traffic signals in real-time. Rectangular Rapid Flashing Beacons (RRFBs) alert drivers to pedestrian presence, while overhead LED signage prevents obstruction by snowplows. Connected crosswalks can integrate with vehicle-to-infrastructure (V2I) technology to improve traffic flow. Solar power options reduce energy costs, and ADA-compliant features ensure accessibility. Regular maintenance and grant funding opportunities can support long-term implementation.

Implementation Matrix

The recommended implementation matrix for transportation improvement projects and policies is presented in **Tables 5-8**. Projects are color-coded and categorized into seven groups, as illustrated in the **Figure 25** legend. This structure helps prioritize improvements and align them with the City's transportation goals.

Figure 27: Project Implementation Legend

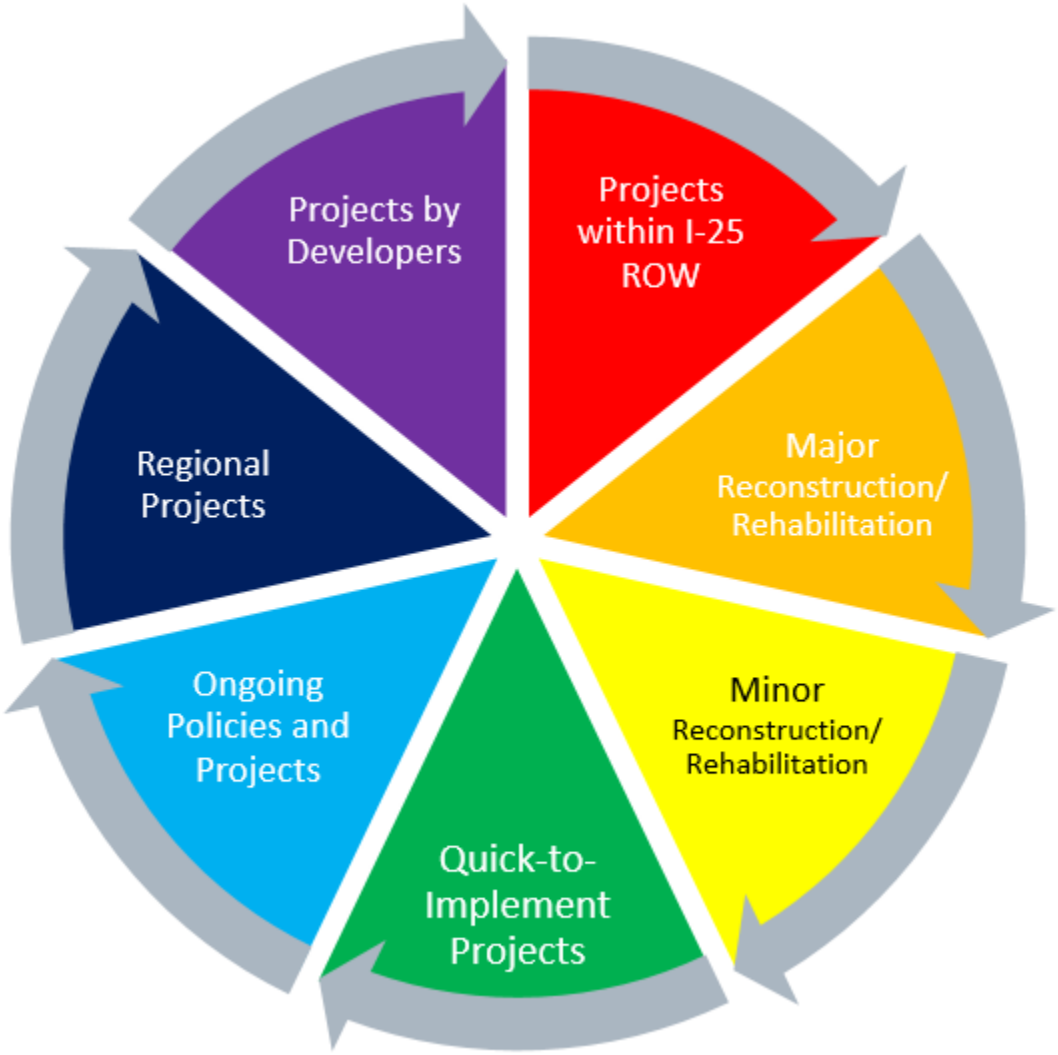


Table 5: City Projects

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
1	Optimize signal timing along Castle Pines Pkwy corridor		Ongoing	City	Traffic operations
2	School Safety: Signage and Striping Improvements for 4 Schools		Short	City	Schools, safety, traffic operations
3	School Safety: Drop-off/pick-up Lane Improvements at Buffalo Ridge		Short	City	Schools
4	School Safety: Castle Pines Pkwy and Charter Oaks Intersection Improvements		Short	City	Schools, Combine with SS4A project
5	Monarch Blvd and Buffalo Trail Roundabout		Short	City	Traffic operations
6	Castle Pines Pkwy rehabilitation (Village Square Drive to Beverly Blvd)		Short	City	Traffic operations, Combine with SS4A project
6a	Reconstruct the Castle Pines Pkwy & Debbie Lane intersection with dedicated NB and SB left-turn, through, and right-turn lanes				Traffic operations
7	Castle Pines Pkwy rehabilitation (Monarch Blvd to Forest Park Drive)		Short	City	Rehabilitation
8	Castle Pines Pkwy rehabilitation (Forest Park Drive to Buffalo Trail)		Short	City	Rehabilitation
9	Monarch Blvd reconstruction (Berganot Trail to Winter Berry Place)		Short	City	Traffic operations
10	Monarch Blvd reconstruction (Castle Pines Pkwy to Shoreham Circle)		Short	City	Traffic operations, safety, schools, include school safety improvements
11	Complete sidewalk and trail projects per Final Trails Master Plan		Ongoing	City/Developer/County	Safety, pedestrian
12	Construct a new bicycle and pedestrian bridge over I-25		Long	City	Safety, from SS4A Plan
	Projects from SS4A Plan				
13	Castle Pines Pkwy/Debbie Ln		Short	City	
13a	Consider signage indicating where to access businesses.				Regional
13b	Convert left turn traffic signals to flashing yellow arrow and restrict left turns when a pedestrian pushes the button to cross.				Traffic operations
13c	Add retroreflective backplates on all signal heads.				Traffic operations, safety

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
13d	Add signage and striping on northbound and southbound approaches to clarify lane assignments and split phase the northbound and southbound approaches to the signal.				Traffic operations, safety, policies
13e	Add "Do Not Block The Box" striping on Debbie Lane at the 7-11 entrance.				Traffic operations, safety
13f	~~Add high friction surface treatment on Castle Pines approaches to the intersection.~~				Recommend to delete
14	Castle Pines Pkwy/Charter Oaks Dr		Short	City	
14a	Convert left turn traffic signals to flashing yellow arrow and restrict left turns when a pedestrian pushes the button to cross.				Traffic operations, safety
14b	Add retroreflective backplates for all signal heads.				Traffic operations, safety
14c	Update striping within the intersection.				Traffic operations, safety
14d	~~Add high friction surface treatment on Castle Pines approaches to the intersection.~~				Recommend to delete
15	Castle Pines Pkwy/Lagae Rd		Short	City	
15a	Conduct a stopping sight distance evaluation for eastbound vehicles.				Safety, policies
15b	Add retroreflective backplates on all signal heads.				Traffic operations, safety
15c	~~Add high friction surface treatment on Castle Pines approaches to the intersection.~~				Recommend to delete
16	Castle Pines Pkwy/Canyonside Blvd		Short	City	
16a	Observe future crash patterns to determine if the traffic signal has addressed historic crash patterns.				Safety
16b	Review yellow and red clearance times to ensure adequate time for downhill vehicles to stop.				Safety
17	Monarch Blvd/Briar Cliff Dr		Short	City	
17a	Conduct a pilot project and install Streiter Lite reflectors to reduce wildlife crashes.				Safety

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
17b	Work with property management company to improve maintenance of landscaping causing poor sight distance.				Safety, regional
18	Monarch Blvd/Glen Oaks Ave		Short	City	
18a	Conduct a pilot project to install zig zag roadway striping on the approaches to the crosswalk to slow vehicles.				Safety, policies
18b	Conduct regular maintenance of landscaping to improve sight distance to approaching trail users.				Safety, policies
19	Castle Pines Pkwy/Cross Canyon Trl: Add rumble strips along the edge line and/or deflectors to improve visibility of the unique westbound geometry.		Short	City	Traffic operations, safety
19a	~~Monarch Blvd/Esperanza Dr: Add high friction surface on Monarch.~~			City	Recommend to delete
20	Monarch Blvd/Bristlewood Ln: Remove the inside northbound lane and expand the raised median to provide a median refuge for pedestrians. Start the northbound left turn lane after the crosswalk.		Mid	City	Safety, pedestrians
21	Castle Pines Pkwy/Yorkshire Dr		Short	City	
21a	Convert left turn signal heads to flashing yellow arrow and restrict left turns when a pedestrian pushes the button to cross.				Traffic operations, safety, pedestrians
21b	Add retroreflective backplates on all signal heads.				Traffic operations, safety
22	Monarch Blvd/Tapadero Way/Serena Ave		Short	City	
22a	Double post eastbound and westbound stop signs and add stop bar pavement markings.				Traffic operations
22b	Either install optical speed bars to reduce southbound speeds approaching the intersection or conduct a pilot project with zig zag roadway striping approaching the crosswalk in both directions.				Traffic operations, safety, policy
22c	Conduct a pilot project and install Streiter Lite reflectors to reduce wildlife crashes.				Traffic operations, safety, policy

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
23	Monarch Blvd/Brambleridge Dr: Conduct pilot project and install Streiter Lite reflectors to reduce wildlife crashes.		Short	City	Traffic operations, safety, policy
24	Lagae Rd/Mira Vista Ln		Short	City	
	Improve the signage striping and lane configuration when approaching the roundabout from the north.				Traffic operations, safety
24a	Divert bicycles up to the sidewalk when approaching the roundabout from all directions.				Traffic operations, safety, pedestrians
25	Lagae Rd/Chase Ln: Install roundabout		Mid	City	Traffic operations

Table 6: Regional Projects

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
31	US 85: Sedalia to Daniels Park Rd		Short	CDOT	Traffic operations
32	US 85: Daniels Park Rd to Meadows Pkwy		Short	CDOT	Traffic operations
33	I-25 and Happy Canyon Road Interchange		Short	CDOT/County/City	Canyons development to contribute funding
33a	Construct a second southbound left-turn lane from the I-25 southbound off-ramp			Developer	Traffic operations
33b	Provide a channelized westbound right-turn lane at the I-25 northbound on-ramp			Developer	Traffic operations
34	Castle Pines to RidgeGate RTD station (Transit Corridor and Microtransit Study)		Mid	County	Pedestrian operations
35	Front Range Passenger Rail		Mid	CDOT/Front Range Passenger Rail Commission	Pedestrian operations
36	Crowfoot Valley Rd Widening (Founders Pkwy to Macanta Blvd/Canyonside Blvd)		Long	County	Traffic operations
37	Crowfoot Valley Rd Widening (Macanta Blvd/Canyonside Blvd to Chambers Rd)		Long	County	Traffic operations
38	Hess Rd Widening (Canyonside Blvd to Chambers Rd)		Long	County	Traffic operations

Table 7: Systemic Policies and Projects

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
51	Participation in Regional Transportation Planning Organizations		Ongoing	City	Policy
52	Travel Demand Management Programs		Ongoing	City	Policy
53	Transit Service Expansion		Ongoing	City	Policy
54	Access Management		Ongoing	City	Policy
55	Complete Streets		Ongoing	City	Policy
56	Intersection Control Analysis		Ongoing	City	Policy
57	Emerging Technologies		Ongoing	City	Policy
58	Traffic Calming and All-Way Stop Control		Ongoing	City	Policy
59	Vision Zero and Public Dashboard		Ongoing	City	Policy
60	Safe Routes to School		Ongoing	City	Policy
61	E-bikes and E-scooters		Ongoing	City	Policy
62	Transit Oriented Development		Ongoing	City	Policy
63	Stormwater and Green Street Policies		Ongoing	City	Policy
64	Intelligent Transportation Systems		Ongoing	City	Policy
65	ADA Compliance		Ongoing	City	Policy
66	Smart Crosswalks		Ongoing	City	Safety, Policy
					Safety, Policy
	Policies and Projects from SS4A Plan				
67	Consider restricting right turn on red and modifying signal timing to allow dedicated pedestrian phases or leading pedestrian intervals.		Ongoing	City	Safety, pedestrian operations
68	Zig zag roadway striping approaching trail crossings, in combination with RRFB's.		Mid	City	Safety, pedestrian operations
69	Evaluate traffic flow around schools and install bulb outs at crosswalks		Mid	City	Combine with reconstruction and rehabilitation projects
70	Bring bike lanes up to minimum width standards during resurfacing projects (as feasible)		Mid	City	Policy, pedestrian operations

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
71	Provide bail outs to transition bikes to the sidewalk when adequate on-street facilities do not exist		Mid	City	Pedestrian operations
72	Monarch south of Castle Pines Pkwy: Narrow vehicle lanes to 10 feet and provide buffered bike lane. Install raised crosswalks with RRFB's.		Short	City	Combine with Monarch Blvd reconstruction
73	Increase the frequency of the existing street sweeping program to address debris in bike lanes		Ongoing	City	Safety, pedestrian operations
74	Monarch north of Castle Pines Pkwy: Evaluate 85th percentile speeds, stopping sight distance and sight triangles for side streets. Determine a safe speed then install physical features to achieve compliance with the target speed.		Short	City	Traffic operations, safety, policy
75	Install red protect technology at signals and evaluate yellow and red clearance times.		Short	City	Traffic operations, policy
76	Monarch, north of Castle Pines Parkway: Pilot project to install lower nighttime speed limits.		Short	City	Traffic operations, safety
	~~Install high friction surface treatments on roads requiring quick stopping due to geometry or speeds~~			City	Recommend to delete
77	Evaluate frequency of existing striping contract		Ongoing	City	Policy
78	The Canyon: Consider installation of no parking signs on one side of the street when the distance from face of curb to face of curb is 28 feet or less. Update design standards to require adequate width to allow parking on both sides of the street.		Short	City	Policy
79	Castle Pines Parkway & Cross Canyon Trail: Extend raised median to obtain compliance of restricting turning movements and add lighting.		Mid	City	Traffic operations
80	Consider the installation of cameras that can detect distracted drivers.		Mid	City	Traffic operations, safety
81	Educational Campaign for young and elderly. Education of newer traffic conditions and controls, when to slow down.		Ongoing	City	Safety, policy
82	Conduct speed studies and install speed feedback signs and other traffic calming measures where appropriate. Work with County Sheriff to enforce speeds.		Ongoing	City	Safety, policy
83	Educational campaign on roundabouts.		Ongoing	City	Policies

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
84	Restrict permissive left turns at signalized intersections where negative left turn offsets exist. At unsignalized intersections where approach turn crashes are more common, consider an all way stop or roundabout.		Ongoing	City	Traffic operations
85	Specific Castle Pines Parkway: Work with CDOT to add signage on I-25 off ramp indicating that vehicles who desire to turn left at Debbie Lane should use the inside right turn lane.		Short	City	Traffic operations
86	Ensure a qualified traffic engineer reviews and approves any traffic control plans and that field inspection with necessary adjustments are implemented.		Ongoing	City	Policy
87	Identify standard for RRFB's and update signage to meet the standard.		Short	City	Combine with reconstruction and rehabilitation projects

Table 8: Canyons Development Projects

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
101	Construct a third westbound through lane along Hess Road at the Castle Pines Pkwy / Hess Road & Havana Street intersection. This should be a continuous lane from Canyonside Blvd to the I-25 northbound ramps. Provide a dedicated westbound right-turn deceleration lane.		Long	County/City	Traffic operations
102	When warranted, signalize the intersection of Crowfoot Valley Road and Sapphire Pointe Blvd. Provide a dedicated eastbound left-turn lane and protected / permitted phasing. As an option, the Town of Castle Rock has proposed a roundabout at this location, which could also provide acceptable operations.		Long	County/Town of Castle Rock	Traffic operations
103	When warranted, signalize the intersection of Crowfoot Valley Road and Canyonside Blvd / Macanta Drive. Provide a dedicated eastbound left-turn lane and protected / permitted phasing. Construct a westbound right turn lane.		Long	Developer	Traffic operations

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
104	Widen Happy Canyon Road to a four-lane cross-section between Canyonside Blvd and I-25.		Long	Developer	Traffic operations
105	Construct a continuous acceleration lane on southbound Canyonside Blvd between Hess Road and Canyon Forge Drive. This lane should terminate as the southbound right-turn lane at Canyon Forge Drive.		Long	Developer	Traffic operations
106	Construct a dedicated northbound right-turn storage lane on Canyonside Blvd at Canyon Forge Drive.		Long	Developer	Traffic operations
107	Create a dedicated eastbound right-turn lane at the Happy Canyon Road and Canyonside Blvd intersection. Additionally, construct a southbound acceleration lane to allow for free right-turn movements.		Long	Developer	Traffic operations
108	Construct the east leg of the Canyonside Blvd and PA-13 Access intersection with separate left-turn and right-turn lanes. When warranted, signalize the intersection, providing a single southbound left-turn lane with protected / permitted phasing and a dedicated northbound right-turn lane.		Mid	Developer	Traffic operations
109	Construct the minor street approaches to the PA-14 / PA-15 South Access intersection, providing single approach lanes and two-way stop control.		Mid	Developer	Traffic operations
	Potential Improvements Related to High School				
110	Modify the Canyonside Blvd / Macanta Drive intersection to provide dual southbound left-turn lanes and overlap phasing for southbound right-turns.		Long	City/School District	Traffic operations
111	Modify the PA-13 Access intersection to provide dual southbound left-turn lanes with protected phasing and overlap phasing for westbound right-turns.		Long	City/School District	Traffic operations
112	Construct a second southbound lane on the PA-1 approach to the Hess Road and Canyonside Blvd intersection.		Long	Developer	Traffic operations
113	Convert the northbound right-turn lane at Canyonside Blvd and Canyon Forge Drive (#10) to a shared through/right-turn lane.		Long	Developer	Traffic operations

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
114	Construct Canyonside Blvd as a four-lane arterial from Castle Pines Pkwy to south of Sweet Creek Lane		Mid	Developer	Traffic operations
115	Widen Castle Pines Pkwy from two lanes to four lanes between Cross Canyon Trail and east of Canyon Forge Drive		Mid	County/City	Traffic operations
116	Realign Havana Street and signalize the Havana Street & Castle Pines Pkwy intersection when warranted		Mid	Developer	Traffic operations
117	Signalize Canyonside Blvd intersection & Canyon Forge Drive when warranted		Mid	Developer	Traffic operations
118	Construct Castle Pines Pkwy & Canyon Forge Drive as a "continuous T-intersection," providing full-movement access from Canyon Forge Drive with side street stop-control		Mid	Developer	Traffic operations
119	Construct Happy Canyon Road as a two-lane road between I-25 and Canyonside Blvd		Mid	Developer	Traffic operations
120	Construct additional Canyons accesses for the Canyonside Subdivision and Shea Canyons Phase I and Phase II as development occurs		Mid	Developer	Traffic operations
121	Widen Canyonside Blvd as a four-lane arterial from Sweet Creek Lane to south of Westbridge Drive		Mid	Developer	Traffic operations
122	Construct Canyonside Blvd as a two-lane road south of Canyontop Trail; create access for PA-13		Mid	Developer	Traffic operations
123	Interchange Project: Construct an additional SB left-turn lane on the I-25 SB Off-Ramp and widen EB Castle Pines Pkwy over I-25 to provide three through lanes		Long	Developer	Traffic operations
124	Widen Castle Pines Pkwy to provide six through lanes from the I-25 NB Ramps to Cross Canyon Trail		Long	Developer	Traffic operations
125	Widen Happy Canyon Road from two lanes to four lanes		Long	Developer	Traffic operations
126	Construct Canyonside Blvd as a continuous four-lane arterial from Castle Pines Pkwy to Crowfoot Valley Road		Long	Developer	Traffic operations
127	Construct traffic signals at the Canyonside Blvd & Sweet Creek Lane and Castle Pines Pkwy & Canyon Forge Drive intersections when warranted		Long	Developer	Traffic operations

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
128	Construct traffic signal at Crowfoot Valley Road & Sapphire Pointe Blvd when warranted. Consider a roundabout as an option if feasible.		Long	County/Town of Castle Rock	Traffic operations
129	Construct traffic signal at Crowfoot Valley Road & Canyonside Blvd / Macanta Blvd when warranted		Long	Developer	Traffic operations
130	At Castle Pines Pkwy & Canyonside Blvd, provide a NB triple left turn, a second WB left-turn lane, and a SB acceleration lane to accommodate EB to SB right turns		Long	Developer	Traffic operations
131	At Canyonside Blvd & Canyon Forge Drive, provide a second WB left-turn lane and extend the SB acceleration lane from Castle Pines Pkwy to become a SB right-turn lane		Long	Developer	Traffic operations
132	Construct a second NB left-turn lane at the Canyonside Blvd & Happy Canyon Road intersection		Long	Developer	Traffic operations
133	Construct a SB right-turn lane at Canyonside Blvd & Sweet Creek Lane		Long	Developer	Traffic operations
134	Subject to regional background development, provide additional turn lanes at the Crowfoot Valley Road & Sapphire Pointe Blvd intersection		Long	County/Town of Castle Rock	Traffic operations
135	Subject to regional background development, provide additional turn lanes at the Crowfoot Valley Road & Canyonside Blvd / Macanta Blvd intersection		Long	Developer	Traffic operations
136	Construct Canyonside Blvd access for Canyons Preliminary Plan #3 development, including left-turn lanes from Canyonside Blvd at all locations		Long	Developer	Traffic operations
137	Construct two-lane side street approaches to Canyonside Blvd at Cross Canyon Trail, Canyontop Trail, PA-14 N Access, PA-14 S/PA-15 Access, PA-16 Access, PA-17/PA-18 Access, and PA-18/PA-19 Access		Long	Developer	Traffic operations
138	When warranted, signalize the Canyonside Blvd & PA-13 Access intersection; construct a dedicated WB right-turn lane		Long	Developer	Traffic operations
139	When warranted, signalize the Canyonside Blvd & School Site Access intersection; construct two EB left turn lanes and a dedicated SB right-turn lane		Long	Developer	Traffic operations

Project No	Location and Description	Project Type	Timeframe	Responsibility	Notes and TMP Category
140	Construct a second EB right-turn lane (with overlap phasing) at the Castle Pines Pkwy & Canyonside Blvd intersection		Long	Developer	Traffic operations
141	Construct a second EB left-turn and channelized right-turn lane at the Canyonside Blvd & Happy Canyon Road intersection		Long	Developer	Traffic operations
142	Construct a second EB left-turn at the Castle Pines Pkwy & Havana Street intersection		Long	Developer	Traffic operations
143	Construct a second EB left-turn lane and a shared NB through / right-turn lane at the Crowfoot Valley Road & Canyonside Blvd / Macanta Blvd		Long	Developer	Traffic operations

Appendices

Appendix A: School Traffic and Monarch Boulevard Safety Traffic Letter

Traffic Letter

To:	**City of Castle Pines**
From:	**Eli Farney, PE, PTOE**
Date:	**January 27, 2025**

School Traffic and Monarch Blvd Safety

Castle Pines, Colorado

Prepared By:

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Introduction

JR Engineering (JR) has completed a review of the traffic operations related to schools in Castle Pines, Colorado (City). The purpose of this Letter is to identify existing operational issues and propose improvement alternatives.

The scope of this Letter includes safety and traffic calming improvement alternatives to Monarch Boulevard between Castle Pines Parkway and Lagae Road.

Additionally, JR considered traffic operations in the vicinity of the following schools:

- Buffalo Ridge Elementary School
- American Academy
- Timber Trail Elementary School
- DCS Montessori School

This Letter includes alternatives to help improve traffic operations in the vicinity of the schools.

Existing Conditions

Buffalo Ridge Elementary School

Buffalo Ridge Elementary School, a public institution with approximately 400 students, is located east of Monarch Boulevard and accessible via Campden Place and Shoreham Drive. Vehicle queuing challenges during drop-off and pick-up times have been identified by the City and school staff. These issues were confirmed by JR during site visits conducted in October and November 2024. A portion of the students utilize bus transportation. The school is illustrated in **Figure 1**.

American Academy

American Academy Castle Pines, a K-8 public charter school with approximately 900 students, is located on Mira Vista Lane, accessible via Lagae Road. Vehicle queuing challenges during drop-off and pick-up times have been identified by the City and school staff and were confirmed by JR during site visits in November 2024. Additionally, nearby residents have reported concerns about students being dropped off and picked up along residential streets. The school is illustrated in **Figure 2**. The school does not utilize buses for student transportation. JR notes that a path was recently constructed to connect Monarch Boulevard to the school.

In the fall of 2024, the City addressed resident concerns by installing a drop-off/pick-up lane along northwest-bound Monarch Boulevard and adding signage prohibiting drop-off and pick-up along Stableford Place and Hyland Hills Street.

Monarch Boulevard

Monarch Boulevard is a major north-south thoroughfare in Castle Pines. It has two lanes and a posted speed limit of 35 mph. The City has identified pedestrian safety issues, particularly related to students at the nearby schools. There are multiple marked crosswalks, including some with rectangular rapid flashing beacons (RRFB). Existing conditions along Monarch Boulevard are shown in **Figure 3**.

Timber Trail Elementary School

Timber Trail Elementary School, a public institution with approximately 400 students, is located on the north side of Castle Pines Parkway and west of Monarch Boulevard. Vehicle queuing challenges during drop-off and pick-up times have been identified by the City and school staff. These issues were confirmed by JR during site visits conducted in November 2024. A portion of the students utilize bus transportation. The school is illustrated in **Figure 4**.

DCS Montessori School

DCS Montessori School, a K-8 public charter school with approximately 520 students, is located on the north side of Castle Pines Parkway and west of Charter Oaks Drive/Village Square Drive. Vehicle queuing challenges during drop-off and pick-up times have been identified by the City and school staff. These issues were confirmed by JR during site visits conducted in October and November 2024. Additionally, high traffic volumes along Castle Pines Parkway present a challenge for drivers exiting the school. The school is illustrated in **Figure 5**. The school does not utilize buses for student transportation.

Figure 1: Buffalo Ridge Elementary School – Existing Conditions

Figure 2: American Academy – Existing Conditions

Figure 3: Monarch Boulevard – Existing Conditions

Figure 4: Timber Trail Elementary School – Existing Conditions

Figure 5: DCS Montessori School – Existing Conditions

Alternative Analysis

Design Guidelines

JR utilized the following design guidelines:

- *Traffic Operations and Safety at Schools: Recommended Guidelines*, prepared by the Texas Transportation Institute, dated 2004
    - This document will be referred to as the TOSS in this letter.
- *Safe Routes to School Guide, Student Drop-off and Pick-up*, prepared by the Pedestrian and Bicycle Information Center (PBIC) with support from the National Highway Traffic Safety Administration (NHTSA), Federal Highway Administration (FHWA), Centers for Disease Control and Prevention (CDC) and Institute of Transportation Engineers (ITE), dated 2007
- FHWA Traffic Calming ePrimer Website
    - https://highways.dot.gov/safety/speed-management/traffic-calming-eprimer
- Castle Pines Master Transportation Plan, prepared by Bohannan Huston, dated 2017

The *Safe Routes to School Guide* discusses that numerous tools can be used to improve the safety and efficiency of the drop-off and pick-up process at schools including the following:

- Encouraging walking, bicycling and carpooling.
- Curb striping and other pavement markings.
- Signage.
- Separating motor vehicles from pedestrians and bicyclists.
- Adding a drop-off and pick-up lane.
- Assistants to help students exit and enter motor vehicles.
- Adding an off-site queuing lane.
- Temporary street closures and one-way streets.
- Temporary use of school grounds as a drop-off and pick-up zone.
- Education, including maps and frequent reminders using school announcements and newsletters.
- Monitoring and enforcement of drop-off and pick-up policies.

The TOSS document contains information regarding recommended on-site stacking lengths ranging from 800 to 1,500 feet depending on the school type and student population. JR notes that on-site stacking lengths can be also affected by multiple factors including school events, carpooling, bus schedules, and weather conditions.

Buffalo Ridge Elementary School

JR recommends the following improvements to reduce the effects of queuing during drop-off and pick-up times at Buffalo Ridge Elementary School:

- Install missing crosswalk signage at the northern-most intersection of Monarch Boulevard and Shoreham Circle.
- Extend the drop-off/pick-up lane to 1,500 feet by adding a right turn lane on Monarch Boulevard.
- Stripe an off-site queue lane on Tenby Way.
- Create a designated bus drop-off/pick-up lane on Shoreham Drive.
- Extend the existing drop-off/pick-up lane towards Shoreham Drive.

Recommended improvements are shown in **Figure 6**.

American Academy

At American Academy, JR recommends the following improvements to address issues related to vehicle queuing and drop-off/pick-up along residential streets:

- Work with American Academy to implement operational improvements for curbside drop-off and pick-up.

It should be noted that crosswalks are either faded or missing at the intersections of Monarch/Murphy Creek Lane and Monarch/Hyland Hills Street. These improvements are also intended to improve pedestrian safety:

- Add/restripe crosswalks at the intersections of Monarch/Murphy Creek Lane and Monarch/Hyland Hills Street.

Recommended improvements are shown in **Figure 7**. If drop-off and pick-up issues continue to persist along Stableford Place and Hyland Hills Street, the City could consider installing fence.

JR also considered modifying the existing roundabout to provide two continuous lanes when entering the school. Based on discussions with the City, this alternative may not be feasible.

Monarch Boulevard Safety and Traffic Calming

Monarch Boulevard is expected to be reconstructed in 2027. JR recommends short-term improvements which can be completed before 2027, along with long-term improvements which would be completed with the reconstruction project.

JR recommends the following short-term improvements to be implemented before the 2027 reconstruction project:

- Restripe the drive lanes to a width of 10 feet and add buffered bike lanes.
    - This improvement was also identified in the *2024 Safety Action Plan* project.
- Extend the school speed zone south from Buffalo Ridge Elementary School to American Academy.

- Use higher visibility materials for crosswalks.

Recommended short-term improvements are shown in **Figure 8**. Extending the school zone speed limit along Monarch to approximately 4,000 feet creates a relatively long school zone. While this could enhance safety for students and pedestrians, it raises the concern that drivers may be less likely to comply with the reduced speed limit over such a long stretch. Research indicates that overly extended school zones may result in reduced driver compliance, as drivers can become less attentive or frustrated over extended distances of lower speed limits. It should be noted that the school zone speed limit is 20 mph.

During the *2024 Safety Action Plan* project, the City gathered public comments, including a suggestion to update the flashing beacon schedules for school zones to 6:45 AM–9:00 AM and 2:45 PM–4:45 PM. This adjustment would ensure coverage for bus pick-up at Rocky Heights Middle School as well as both drop-off and pick-up at Buffalo Ridge Elementary School, enhancing safety during key times.

In addition to the improvements recommended above, JR notes that the City has expressed interest in reducing the posted speed limit on Monarch Boulevard from 35 mph to 30 mph. This is consistent with the City's *Roadway Design and Construction Standards*. Table 7-1 of the standards specifies a posted speed limit of 30 mph for all collector streets. Monarch is classified as a collector in the *2017 Master Transportation Plan*.

Along with reducing the posted speed limit, JR considered traffic calming measures suggested by the Federal Highway Administration (FHWA). **Table 1** includes a list of potential traffic calming measures from the FHWA. JR selected multiple measures which could be beneficial along Monarch Boulevard including raised crosswalks/intersections and street width reductions. In the table, recommended measures are color-coded. Note that some recommended measures are illustrated in the figures, while others are not shown.

JR recommends the following long-term improvements to be implemented as part of the 2027 reconstruction project:

- Construct bulb-outs, raised intersections, and raised crosswalks to improve pedestrian visibility.
- Improve curb ramps to ensure ADA compliance.
- Fill in remaining sidewalk gaps.
- Provide additional lighting at crosswalks.

Recommended long-term improvements are shown in **Figure 9**.

The City noted that the in-street pedestrian crossing signage along Monarch need to be removed when snow plowing operations are underway. The signs could be mounted overhead to avoid the snow plows.

Clare Drive Intersections

JR recommends adding all-way stop control and striped crosswalks at the intersections of Clare Drive & Yorkshire Drive and Clare Drive & Shoreham Drive. According to the MUTCD, all-way stop control may be appropriate at the intersection of two residential collector streets with similar design and operating characteristics. In the case of the Clare Drive intersections, all-way stop control could improve safety for pedestrians, including students walking to/from Buffalo Ridge Elementary School. This improvement is shown in **Figure 8**.

Timber Trail Elementary School

JR recommends the following improvements to reduce the effects of queuing during drop-off and pick-up times at Timber Trail Elementary School:

- Extend the drop-off/pick-up lane to 1,500 feet by extending the dotted stripe on Castle Pines Parkway.

This improvement is shown in **Figure 10**.

DCS Montessori School

JR performed a level of service (LOS) and queuing analysis at the school access intersection to determine appropriate improvements. The analysis considered the effects of adding a free-flow southbound right turn lane exiting the school. JR also considered the effects of installing a traffic signal. Synchro software results are included in **Appendix B**.

Queue lengths for the southbound right movement may decrease by adding a free-flow right turn lane onto Castle Pines Parkway. In the AM Peak Hour, the estimated queue decreases from 102 feet to 36 feet. In the PM Peak Hour, the estimated queue decreases from 69 feet to 31 feet.

The school access intersection meets the peak hour traffic signal warrant according to the MUTCD. A signal provides the benefit of allowing left turns out of the school, which are currently prohibited during drop-off and pick-up times. JR performed an LOS analysis to determine how a signal would operate. With existing traffic volumes, all movements are expected to operate at LOS C or better. The traffic signal is also expected to decrease queuing at the school exit to 48 feet (SBL, AM), 34 feet (SBR, AM), 33 feet (SBL, PM), and 29 feet (SBR, PM). However, JR notes that the signal spacing would be 450 feet from the existing signal at Charter Oaks Drive. Based on discussions with the City, the spacing likely makes this traffic signal not feasible.

At DCS Montessori School, JR recommends the following improvements to address issues related to vehicle queuing and traffic operations at the school access on Castle Pines Parkway:

- Extend the drop-off/pick-up lane to 1,500 feet by lengthening the right turn lane on Castle Pines Parkway.
- Add a free-flow right turn lane onto Castle Pines Parkway to help drivers exiting the school.
    - U-turns are currently permitted at the Castle Pines Parkway and Lagae Road traffic signal.

These improvements are shown in **Figure 11**.

JR also considered the effects of adding a school access on Charter Oaks Drive. This may not be advisable, however, as it would complicate the flow of traffic on the school site. Additionally, it may cause operational issues along Charter Oaks Drive, which is located in unincorporated Douglas County.

The City also said they are considering school zone speed limits along Charter Oaks Drive and Village Square Drive.

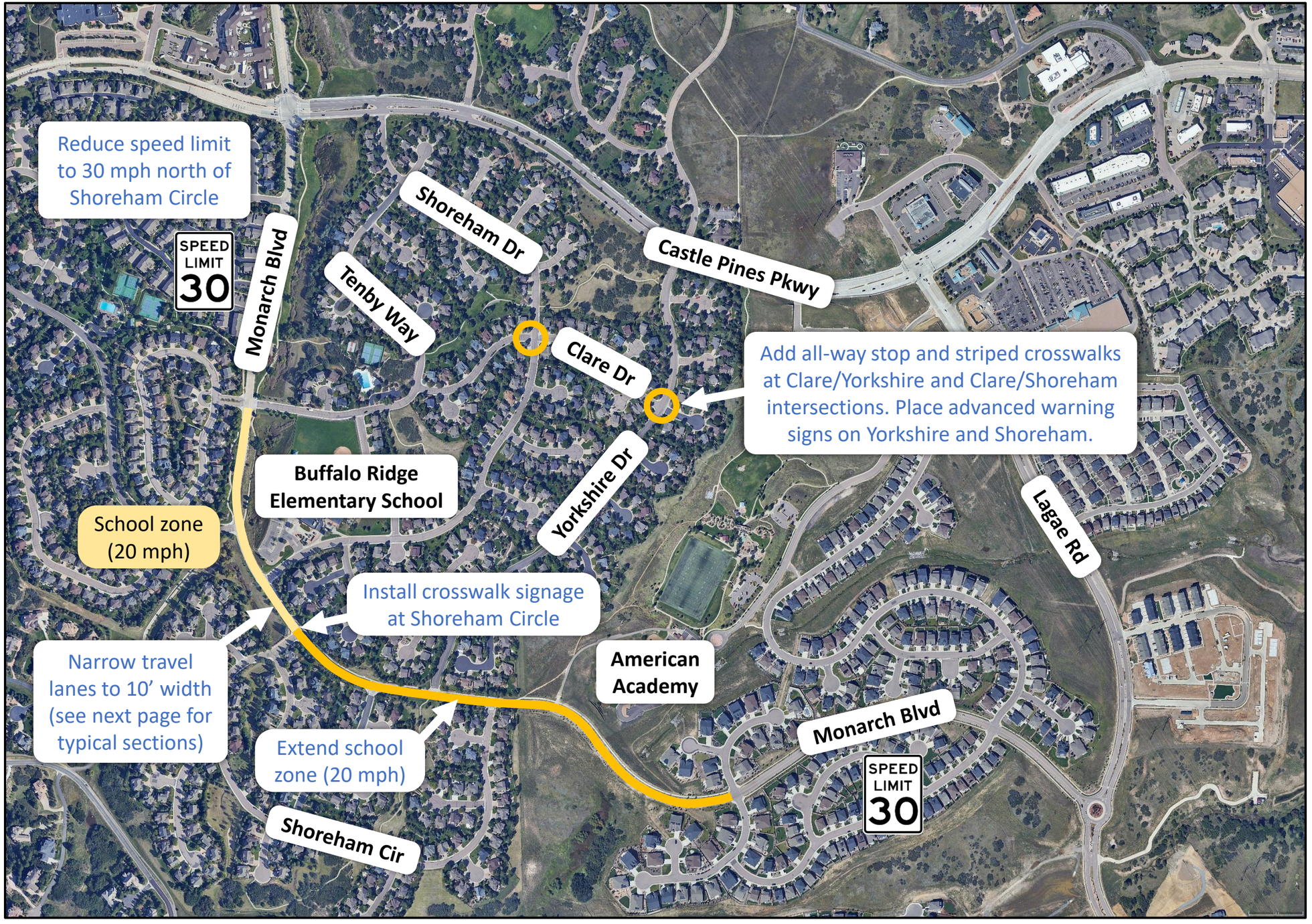
Table 1: FHWA Traffic Calming Measures

Traffic Calming Measure	Segment or Intersection	Applicability for Thoroughfare Classification*
Horizontal Deflection		
Lateral Shift	Segment	3
Chicane	Segment	1
Realigned Intersection	Intersection	1
Traffic Circle	Intersection	1
Small Modern & Mini-Roundabout	Intersection	3
Roundabout	Intersection	5
Vertical Deflection		
Speed Hump	Segment	1
Speed Cushion	Segment	1
Speed Table	Segment	3
Offset Speed Table	Segment	3
Raised Crosswalk	Both	3
Raised Intersection	Intersection	3
Street Width Reduction		
Corner Extension	Intersection	5
Choker	Segment	5
Median Island	Both	5
On-Street Parking	Segment	5
Road Diet	Both	5
Routing Restriction		
Diagonal Diverter	Intersection	1
Full Closure	Both	1
Half Closure	Intersection	1
Median Barrier	Intersection	3
Forced Turn Island	Intersection	3
*Applicability scale: 5 – traffic calming measure may be appropriate 3 – caution; traffic calming measure could be inappropriate 1 – traffic calming measure is likely inappropriate		
Traffic calming measures recommended by JR and shown in figures.		
Traffic calming measures recommended by JR, but not shown.		

Figure 6: Buffalo Ridge Elementary School – Alternative Analysis

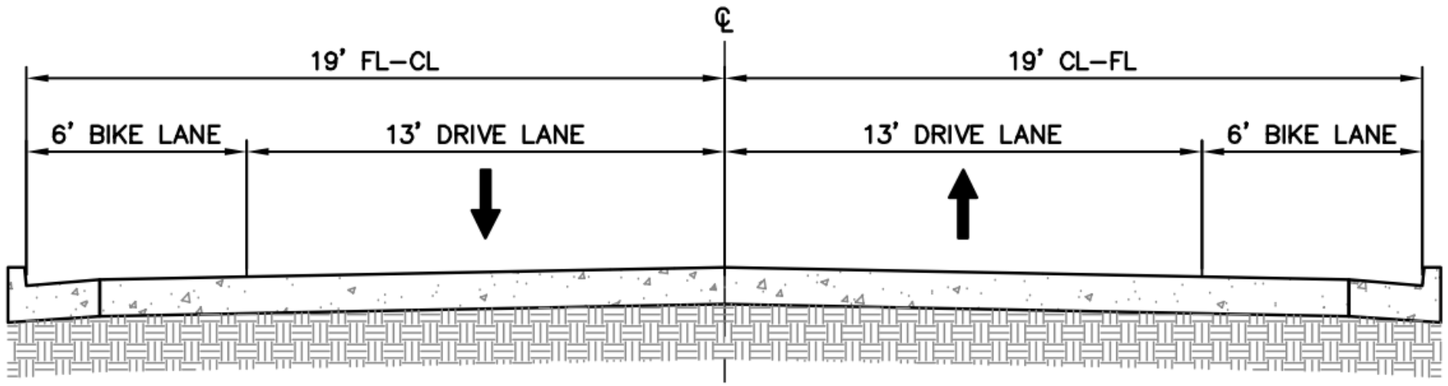
Figure 7: American Academy – Alternative Analysis

Figure 8: Monarch Boulevard – Alternative Analysis (Short-Term)



Monarch Boulevard Typical Sections

Existing



Proposed

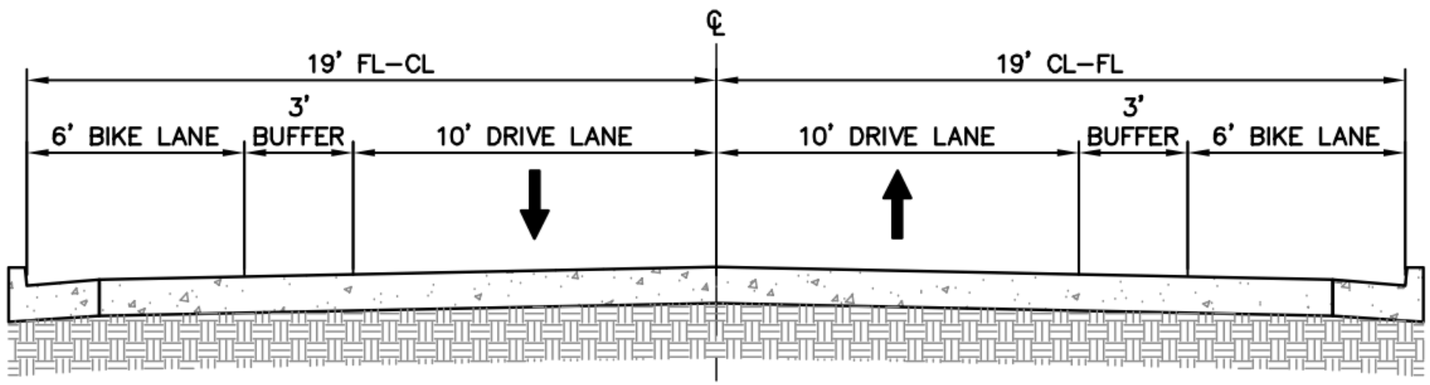


Figure 9: Monarch Boulevard – Alternative Analysis (Long-Term)

Crosswalk Bulb-Out Example

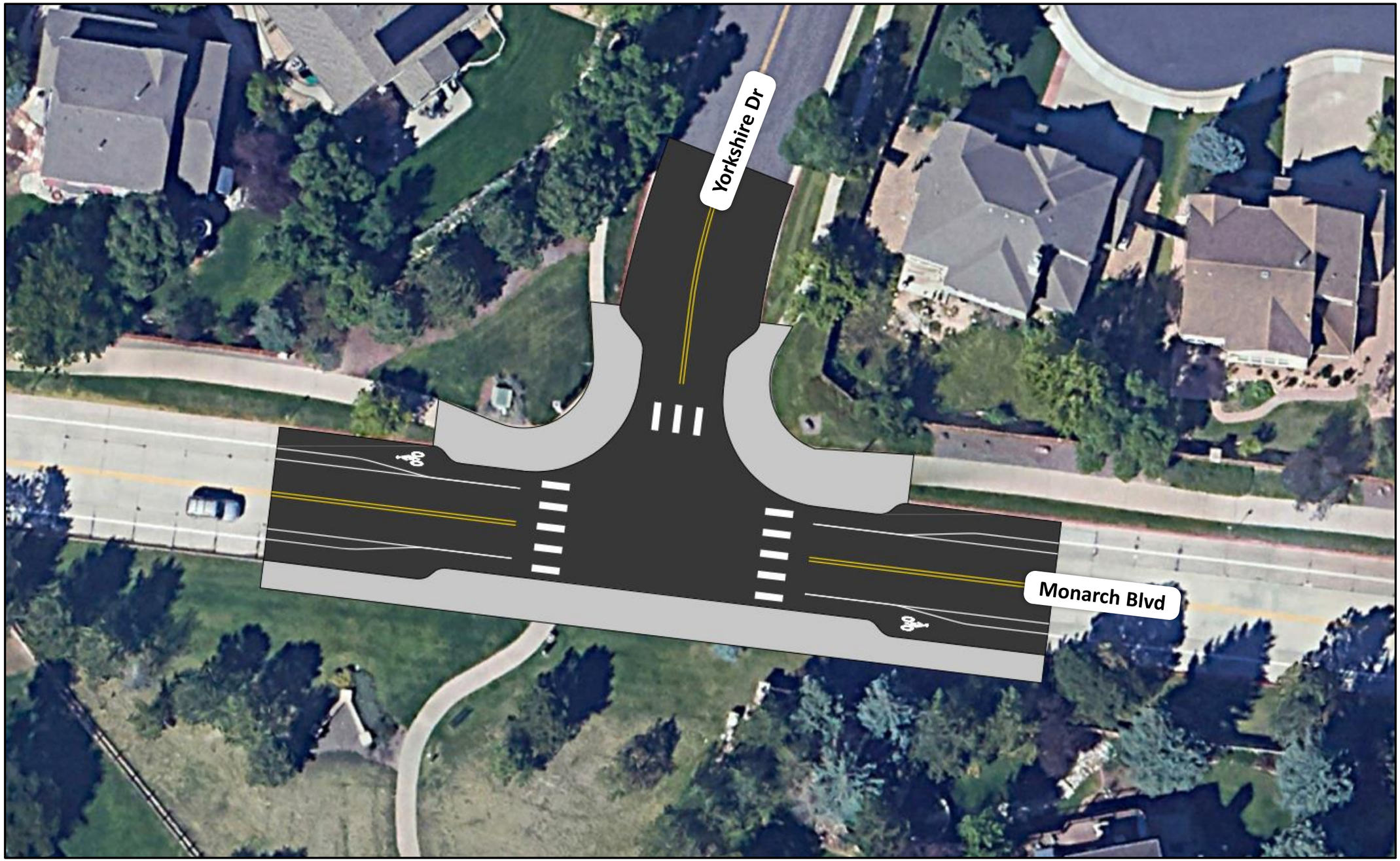
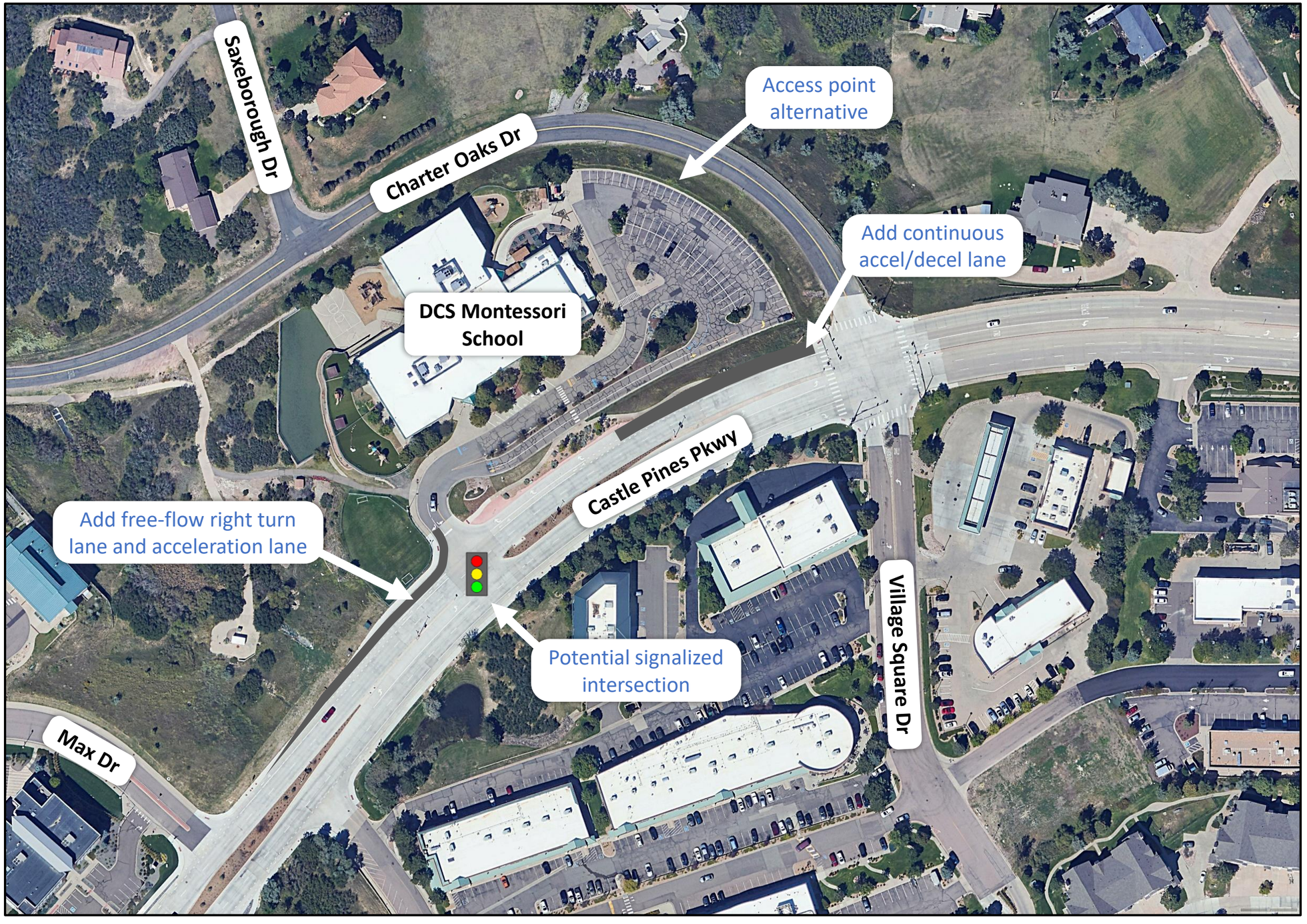


Figure 10: Timber Trail Elementary School – Alternative Analysis

Figure 11: DCS Montessori School – Alternative Analysis



Conclusion

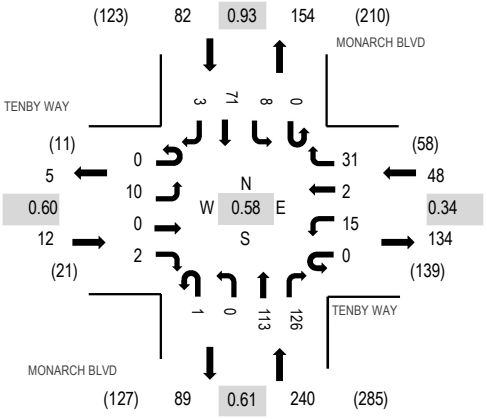
JR recommends advancing the project by scheduling a meeting with the City and school staff to collaboratively review and screen potential alternatives for addressing safety and operational concerns at the schools and along Monarch Boulevard. JR also recommends a site visit with the City. Once the preferred alternative(s) are identified, they should be integrated into the updated transportation plan. This will help ensure that the recommendations are formally documented and can guide future design and funding efforts, particularly in preparation for future projects.

Appendix A: Traffic Counts

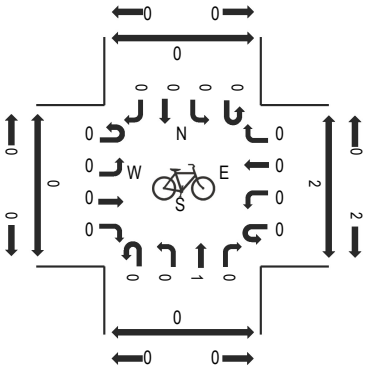
ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

Location: 1 MONARCH BLVD & TENBY WAY AM
Date: Wednesday, October 9, 2024
Peak Hour: 07:30 AM - 08:30 AM
Peak 15-Minutes: 08:15 AM - 08:30 AM

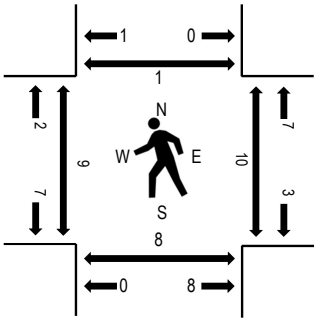
Peak Hour - Motorized Vehicles



Peak Hour - Bicycles



Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

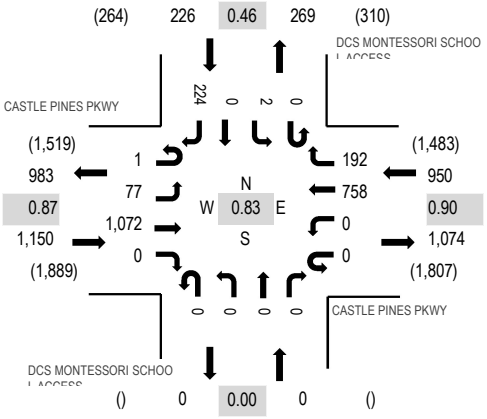
Traffic Counts - Motorized Vehicles

Interval Start Time	TENBY WAY Eastbound				TENBY WAY Westbound				MONARCH BLVD Northbound				MONARCH BLVD Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:30 AM	0	5	0	0	0	0	0	2	0	0	31	0	0	1	21	0	60	382	3	3	0	1
7:45 AM	0	0	0	0	0	0	0	2	0	0	39	6	0	2	19	1	69	365	3	2	0	0
8:00 AM	0	3	0	1	0	0	1	2	1	0	28	36	0	3	12	1	88	320	1	2	1	0
8:15 AM	0	2	0	1	0	15	1	25	0	0	15	84	0	2	19	1	165	247	2	3	7	0
8:30 AM	0	1	0	0	0	1	0	8	0	0	13	5	0	0	15	0	43	105	3	5	1	3
8:45 AM	0	1	0	1	0	0	0	0	0	0	11	0	0	0	8	3	24		3	3	2	0
9:00 AM	0	4	0	0	0	0	0	0	0	0	6	0	0	0	4	1	15		2	3	3	2
9:15 AM	0	2	0	0	0	1	0	0	0	0	10	0	0	0	8	2	23		4	2	0	2
Count Total	0	18	0	3	0	17	2	39	1	0	153	131	0	8	106	9	487		21	23	14	8
Peak Hour	0	10	0	2	0	15	2	31	1	0	113	126	0	8	71	3	382		9	10	8	1

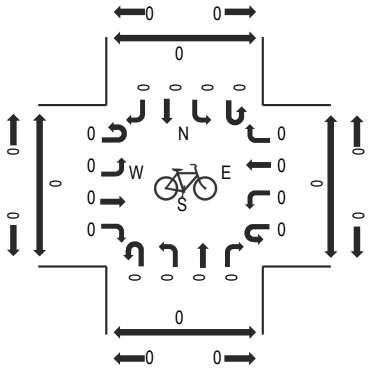
ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

Location: 2 DCS MONTESSORI SCHOOL ACCESS & CASTLE PINES PKWY AM
Date: Wednesday, October 9, 2024
Peak Hour: 07:30 AM - 08:30 AM
Peak 15-Minutes: 08:15 AM - 08:30 AM

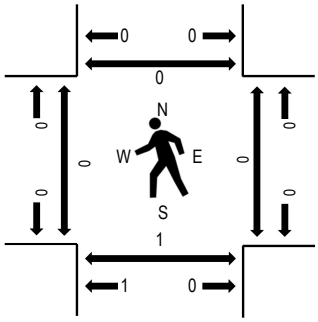
Peak Hour - Motorized Vehicles



Peak Hour - Bicycles



Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	CASTLE PINES PKWY Eastbound				CASTLE PINES PKWY Westbound				DCS MONTESSORI SCHOOL ACCESS				DCS MONTESSORI SCHOOL ACCESS					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:30 AM	1	5	239	0	0	0	200	17	0	0	0	0	0	0	0	6	468	2,326	0	0	0	0
7:45 AM	0	13	234	0	0	0	231	32	0	0	0	0	0	1	0	6	517	2,266	0	0	1	0
8:00 AM	0	26	307	0	0	0	164	60	0	0	0	0	0	0	0	81	638	2,083	0	0	0	0
8:15 AM	0	33	292	0	0	0	163	83	0	0	0	0	0	1	0	131	703	1,721	0	0	0	0
8:30 AM	0	7	246	0	0	0	132	3	0	0	0	0	0	4	0	16	408	1,310	0	0	0	0
8:45 AM	1	7	183	0	0	0	121	14	0	0	0	0	0	3	0	5	334		0	0	0	0
9:00 AM	1	1	135	0	0	0	131	3	0	0	0	0	0	2	0	3	276		0	0	0	0
9:15 AM	0	1	157	0	0	0	124	5	0	0	0	0	0	3	0	2	292		0	0	0	0
Count Total	3	93	1,793	0	0	0	1,266	217	0	0	0	0	0	14	0	250	3,636		0	0	1	0
Peak Hour	1	77	1,072	0	0	0	758	192	0	0	0	0	0	2	0	224	2,326		0	0	1	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
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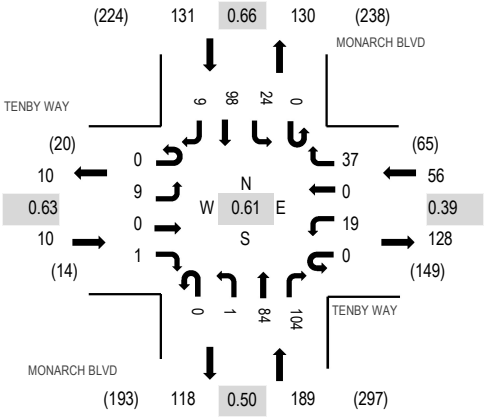
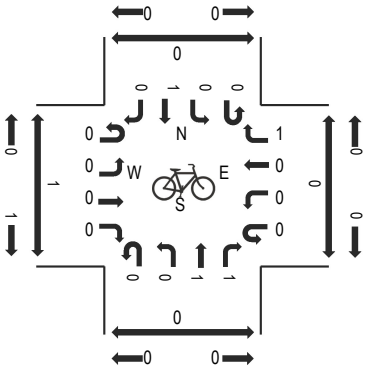
Location: 1 MONARCH BLVD & TENBY WAY PM
Date: Wednesday, October 9, 2024
Peak Hour: 02:45 PM - 03:45 PM
Peak 15-Minutes: 03:15 PM - 03:30 PM

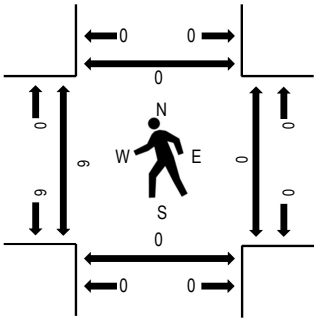
Peak Hour - Motorized Vehicles



Peak Hour - Bicycles



Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	TENBY WAY Eastbound				TENBY WAY Westbound				MONARCH BLVD Northbound				MONARCH BLVD Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:30 PM	0	0	0	0	0	1	0	3	0	1	27	2	0	5	7	3	49	353	2	1	0	0
2:45 PM	0	2	0	1	0	0	0	1	0	0	20	14	0	12	16	2	68	386	0	0	0	0
3:00 PM	0	4	0	0	0	0	0	0	0	1	14	8	0	9	36	5	77	372	2	0	0	0
3:15 PM	0	1	0	0	0	14	0	23	0	0	17	78	0	2	23	1	159	347	1	0	0	0
3:30 PM	0	2	0	0	0	5	0	13	0	0	33	4	0	1	23	1	82	247	3	0	0	0
3:45 PM	0	0	0	0	0	0	0	0	0	0	23	2	0	2	22	5	54		0	0	0	0
4:00 PM	0	1	0	0	0	0	0	3	0	0	23	5	0	1	19	0	52		0	2	0	2
4:15 PM	0	3	0	0	0	0	0	2	0	0	23	2	0	2	26	1	59		2	1	0	0
Count Total	0	13	0	1	0	20	0	45	0	2	180	115	0	34	172	18	600		10	4	0	2
Peak Hour	0	9	0	1	0	19	0	37	0	1	84	104	0	24	98	9	386		6	0	0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
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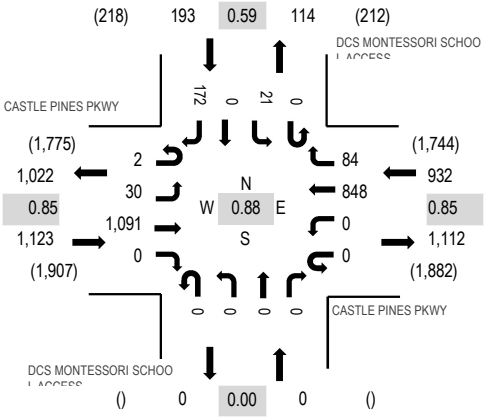
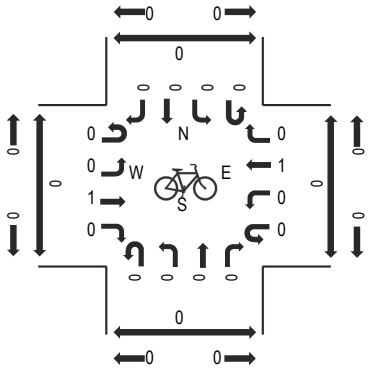
Location: 2 DCS MONTESSORI SCHOOL ACCESS & CASTLE PINES PKWY PM
Date: Wednesday, October 9, 2024
Peak Hour: 03:15 PM - 04:15 PM
Peak 15-Minutes: 03:30 PM - 03:45 PM

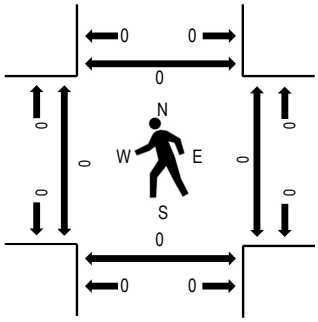
Peak Hour - Motorized Vehicles



Peak Hour - Bicycles



Peak Hour - Pedestrians

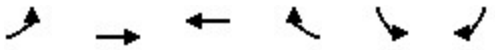


Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	CASTLE PINES PKWY Eastbound				CASTLE PINES PKWY Westbound				DCS MONTESSORI SCHOOL ACCESS				DCS MONTESSORI SCHOOL ACCESS					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:30 PM	0	4	169	0	0	0	165	10	0	0	0	0	0	4	0	4	356	1,772	0	0	0	0
2:45 PM	1	11	167	0	0	0	195	28	0	0	0	0	0	5	0	2	409	2,052	0	0	1	1
3:00 PM	0	4	192	0	0	0	197	18	0	0	0	0	0	2	0	1	414	2,227	0	0	0	0
3:15 PM	0	12	219	0	0	0	230	53	0	0	0	0	0	0	0	79	593	2,248	0	0	0	0
3:30 PM	2	10	311	0	0	0	214	17	0	0	0	0	0	1	0	81	636	2,097	0	0	0	0
3:45 PM	0	4	329	0	0	0	223	10	0	0	0	0	0	11	0	7	584		0	0	0	0
4:00 PM	0	4	232	0	0	0	181	4	0	0	0	0	0	9	0	5	435		0	0	0	0
4:15 PM	0	7	229	0	0	0	183	16	0	0	0	0	0	2	0	5	442		0	0	0	0
Count Total	3	56	1,848	0	0	0	1,588	156	0	0	0	0	0	34	0	184	3,869		0	0	1	1
Peak Hour	2	30	1,091	0	0	0	848	84	0	0	0	0	0	21	0	172	2,248		0	0	0	0

Appendix B: Synchro Reports for DCS Montessori School



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1072	758	192	0	224
Future Volume (vph)	77	1072	758	192	0	224
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	165			150	0	0
Storage Lanes	1			1	0	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt				0.850		0.865
Flt Protected	0.950					
Satd. Flow (prot)	1770	3539	3539	1583	0	1611
Flt Permitted	0.950					
Satd. Flow (perm)	1770	3539	3539	1583	0	1611
Link Speed (mph)		25	25		25	
Link Distance (ft)		873	579		728	
Travel Time (s)		23.8	15.8		19.9	
Peak Hour Factor	0.58	0.87	0.82	0.58	0.50	0.43
Adj. Flow (vph)	133	1232	924	331	0	521
Shared Lane Traffic (%)						
Lane Group Flow (vph)	133	1232	924	331	0	521
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		0	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	41.5%	ICU Level of Service	A
Analysis Period (min)	15		

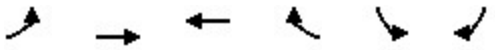
Intersection	
Int Delay, s/veh	9.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	77	1072	758	192	0	224
Future Vol, veh/h	77	1072	758	192	0	224
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	165	-	-	150	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	58	87	82	58	50	43
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	133	1232	924	331	0	521

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1255	0	-	0	-	462
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	4.14	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.22	-	-	-	-	3.32
Pot Cap-1 Maneuver	550	-	-	-	0	546
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %			-	-	-	
Mov Cap-1 Maneuver	550	-	-	-	-	546
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s/v	1.32	0	55.31
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	550	-	-	-	546
HCM Lane V/C Ratio	0.241	-	-	-	0.953
HCM Control Delay (s/veh)	13.6	-	-	-	55.3
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.9	-	-	-	12.5



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	30	1091	848	84	0	172
Future Volume (vph)	30	1091	848	84	0	172
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	165			150	0	0
Storage Lanes	1			1	0	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt				0.850		0.865
Flt Protected	0.950					
Satd. Flow (prot)	1770	3539	3539	1583	0	1611
Flt Permitted	0.950					
Satd. Flow (perm)	1770	3539	3539	1583	0	1611
Link Speed (mph)		25	25		25	
Link Distance (ft)		873	579		747	
Travel Time (s)		23.8	15.8		20.4	
Peak Hour Factor	0.63	0.83	0.92	0.40	0.48	0.53
Adj. Flow (vph)	48	1314	922	210	0	325
Shared Lane Traffic (%)						
Lane Group Flow (vph)	48	1314	922	210	0	325
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		0	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	40.8%	ICU Level of Service	A
Analysis Period (min)	15		

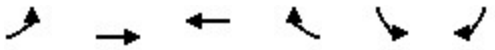
Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	30	1091	848	84	0	172
Future Vol, veh/h	30	1091	848	84	0	172
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	165	-	-	150	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	63	83	92	40	48	53
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	48	1314	922	210	0	325

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1132	0	-	0	-	461
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	4.14	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.22	-	-	-	-	3.32
Pot Cap-1 Maneuver	613	-	-	-	0	547
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %			-	-	-	
Mov Cap-1 Maneuver	613	-	-	-	-	547
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s/v	0.4	0	20.7
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	613	-	-	-	547
HCM Lane V/C Ratio	0.078	-	-	-	0.593
HCM Control Delay (s/veh)	11.4	-	-	-	20.7
HCM Lane LOS	B	-	-	-	C
HCM 95th %tile Q(veh)	0.3	-	-	-	3.8

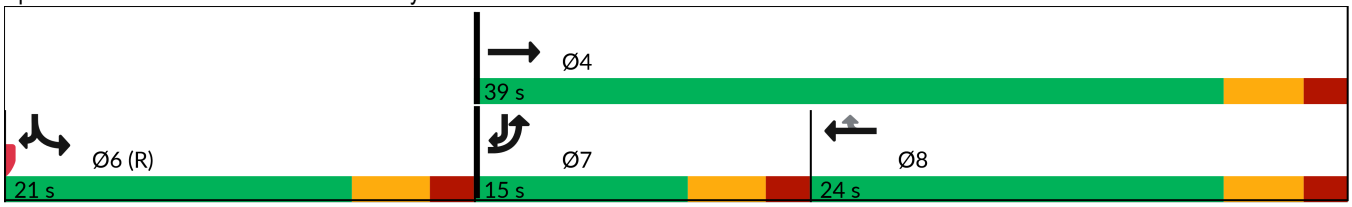


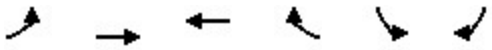
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	1072	758	192	76	150
Future Volume (vph)	77	1072	758	192	76	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	165			150	0	0
Storage Lanes	1			1	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.95
Frt				0.850	0.948	0.850
Flt Protected	0.950				0.968	
Satd. Flow (prot)	1770	3539	3539	1583	1709	1504
Flt Permitted	0.950				0.968	
Satd. Flow (perm)	1770	3539	3539	1583	1709	1504
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				331	43	18
Link Speed (mph)		25	25		25	
Link Distance (ft)		873	579		734	
Travel Time (s)		23.8	15.8		20.0	
Peak Hour Factor	0.58	0.87	0.82	0.58	0.43	0.43
Adj. Flow (vph)	133	1232	924	331	177	349
Shared Lane Traffic (%)						27%
Lane Group Flow (vph)	133	1232	924	331	271	255
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (ft)	20	100	100	20	20	20
Trailing Detector (ft)	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	6	20	20	20
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94	94			
Detector 2 Size(ft)		6	6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Prot	NA	NA	Perm	Prot	pt+ov
Protected Phases	7	4	8		6	6 7
Permitted Phases				8		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector Phase	7	4	8	8	6	6 7
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	10.5	23.5	23.5	23.5	23.5	
Total Split (s)	15.0	39.0	24.0	24.0	21.0	
Total Split (%)	25.0%	65.0%	40.0%	40.0%	35.0%	
Maximum Green (s)	9.5	33.5	18.5	18.5	15.5	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	C-Max	
Walk Time (s)		7.0	7.0	7.0	7.0	
Flash Don't Walk (s)		11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)		0	0	0	0	
Act Effct Green (s)	8.5	32.8	18.8	18.8	16.2	30.2
Actuated g/C Ratio	0.14	0.55	0.31	0.31	0.27	0.50
v/c Ratio	0.53	0.64	0.84	0.46	0.55	0.33
Control Delay (s/veh)	31.6	11.2	28.0	4.6	21.0	9.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	31.6	11.2	28.0	4.6	21.0	9.7
LOS	C	B	C	A	C	A
Approach Delay (s/veh)		13.2	21.8		15.5	
Approach LOS		B	C		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay (s/veh): 17.0		Intersection LOS: B	
Intersection Capacity Utilization 46.2%		ICU Level of Service A	
Analysis Period (min) 15			

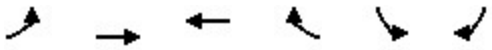
Splits and Phases: 1: Castle Pines Pkwy & School Access





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	133	1232	924	331	271	255
v/c Ratio	0.53	0.64	0.84	0.46	0.55	0.33
Control Delay (s/veh)	31.6	11.2	28.0	4.6	21.0	9.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	31.6	11.2	28.0	4.6	21.0	9.7
Queue Length 50th (ft)	45	141	162	0	70	48
Queue Length 95th (ft)	55	186	200	0	48	34
Internal Link Dist (ft)		793	499		654	
Turn Bay Length (ft)	165			150		
Base Capacity (vph)	280	1975	1106	722	492	790
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.62	0.84	0.46	0.55	0.32

Intersection Summary



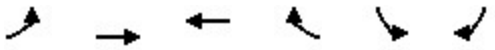
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	77	1072	758	192	76	150
Future Volume (veh/h)	77	1072	758	192	76	150
Initial Q (Qb), veh	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No	No		No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	133	1232	924	331	257	0
Peak Hour Factor	0.58	0.87	0.82	0.58	0.43	0.43
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	171	1733	1066	475	586	
Arrive On Green	0.10	0.49	0.30	0.30	0.33	0.00
Sat Flow, veh/h	1781	3647	3647	1585	1781	1585
Grp Volume(v), veh/h	133	1232	924	331	257	0
Grp Sat Flow(s),veh/h/ln	1781	1777	1777	1585	1781	1585
Q Serve(g_s), s	4.4	16.3	14.8	11.1	6.8	0.0
Cycle Q Clear(g_c), s	4.4	16.3	14.8	11.1	6.8	0.0
Prop In Lane	1.00			1.00	1.00	1.00
Lane Grp Cap(c), veh/h	171	1733	1066	475	586	
V/C Ratio(X)	0.78	0.71	0.87	0.70	0.44	
Avail Cap(c_a), veh/h	282	1984	1096	489	586	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	26.5	12.1	19.9	18.6	15.8	0.0
Incr Delay (d2), s/veh	7.4	1.0	7.4	4.2	2.4	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	5.8	6.7	4.3	2.9	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d), s/veh	33.9	13.1	27.3	22.8	18.2	0.0
LnGrp LOS	C	B	C	C	B	
Approach Vol, veh/h		1365	1255		257	
Approach Delay, s/veh		15.1	26.1		18.2	
Approach LOS		B	C		B	

Timer - Assigned Phs	4	6	7	8
Phs Duration (G+Y+Rc), s	34.8	25.2	11.3	23.5
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	33.5	15.5	9.5	18.5
Max Q Clear Time (g_c+I1), s	18.3	8.8	6.4	16.8
Green Ext Time (p_c), s	8.2	0.4	0.1	1.2

Intersection Summary	
HCM 7th Control Delay, s/veh	20.2
HCM 7th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.

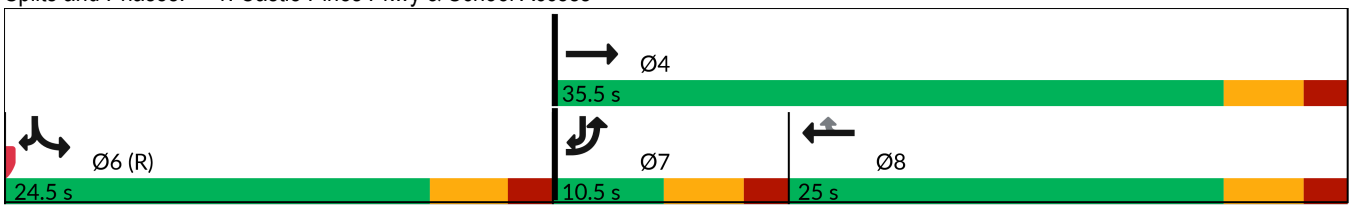


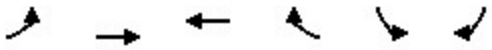
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	30	1091	848	84	57	115
Future Volume (vph)	30	1091	848	84	57	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	165			150	0	0
Storage Lanes	1			1	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.95
Frt				0.850	0.952	0.850
Flt Protected	0.950				0.967	
Satd. Flow (prot)	1770	3539	3539	1583	1715	1504
Flt Permitted	0.950				0.967	
Satd. Flow (perm)	1770	3539	3539	1583	1715	1504
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				210	41	23
Link Speed (mph)		25	25		25	
Link Distance (ft)		873	579		747	
Travel Time (s)		23.8	15.8		20.4	
Peak Hour Factor	0.63	0.83	0.92	0.40	0.48	0.53
Adj. Flow (vph)	48	1314	922	210	119	217
Shared Lane Traffic (%)						26%
Lane Group Flow (vph)	48	1314	922	210	175	161
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (ft)	20	100	100	20	20	20
Trailing Detector (ft)	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	6	20	20	20
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94	94			
Detector 2 Size(ft)		6	6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Prot	NA	NA	Perm	Prot	pt+ov
Protected Phases	7	4	8		6	6 7
Permitted Phases				8		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector Phase	7	4	8	8	6	6 7
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	10.5	23.5	23.5	23.5	23.5	
Total Split (s)	10.5	35.5	25.0	25.0	24.5	
Total Split (%)	17.5%	59.2%	41.7%	41.7%	40.8%	
Maximum Green (s)	5.0	30.0	19.5	19.5	19.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	C-Max	
Walk Time (s)		7.0	7.0	7.0	7.0	
Flash Don't Walk (s)		11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)		0	0	0	0	
Act Effct Green (s)	5.0	29.0	20.6	20.6	20.0	30.5
Actuated g/C Ratio	0.08	0.48	0.34	0.34	0.33	0.51
v/c Ratio	0.33	0.77	0.76	0.31	0.29	0.21
Control Delay (s/veh)	32.3	16.2	23.2	4.1	13.4	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	32.3	16.2	23.2	4.1	13.4	8.2
LOS	C	B	C	A	B	A
Approach Delay (s/veh)		16.8	19.7		10.9	
Approach LOS		B	B		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.77			
Intersection Signal Delay (s/veh): 17.2		Intersection LOS: B	
Intersection Capacity Utilization 44.8%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 1: Castle Pines Pkwy & School Access

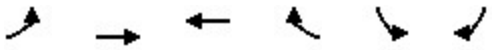




Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	48	1314	922	210	175	161
v/c Ratio	0.33	0.77	0.76	0.31	0.29	0.21
Control Delay (s/veh)	32.3	16.2	23.2	4.1	13.4	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	32.3	16.2	23.2	4.1	13.4	8.2
Queue Length 50th (ft)	17	183	157	0	35	27
Queue Length 95th (ft)	31	222	#230	0	33	29
Internal Link Dist (ft)		793	499		667	
Turn Bay Length (ft)	165			150		
Base Capacity (vph)	147	1769	1217	682	598	775
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.74	0.76	0.31	0.29	0.21

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	30	1091	848	84	57	115
Future Volume (veh/h)	30	1091	848	84	57	115
Initial Q (Qb), veh	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No	No		No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	48	1314	922	210	165	0
Peak Hour Factor	0.63	0.83	0.92	0.40	0.48	0.53
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	82	1605	1116	498	650	
Arrive On Green	0.05	0.45	0.31	0.31	0.36	0.00
Sat Flow, veh/h	1781	3647	3647	1585	1781	1585
Grp Volume(v), veh/h	48	1314	922	210	165	0
Grp Sat Flow(s),veh/h/ln	1781	1777	1777	1585	1781	1585
Q Serve(g_s), s	1.6	19.3	14.4	6.3	3.9	0.0
Cycle Q Clear(g_c), s	1.6	19.3	14.4	6.3	3.9	0.0
Prop In Lane	1.00			1.00	1.00	1.00
Lane Grp Cap(c), veh/h	82	1605	1116	498	650	
V/C Ratio(X)	0.59	0.82	0.83	0.42	0.25	
Avail Cap(c_a), veh/h	148	1777	1155	515	650	
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	28.1	14.3	19.1	16.3	13.3	0.0
Incr Delay (d2), s/veh	6.5	2.9	4.9	0.6	0.9	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	7.4	6.2	2.2	1.6	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d), s/veh	34.6	17.2	24.0	16.8	14.3	0.0
LnGrp LOS	C	B	C	B	B	
Approach Vol, veh/h		1362	1132		165	
Approach Delay, s/veh		17.8	22.7		14.3	
Approach LOS		B	C		B	

Timer - Assigned Phs	4	6	7	8
Phs Duration (G+Y+Rc), s	32.6	27.4	8.3	24.3
Change Period (Y+Rc), s	5.5	5.5	5.5	5.5
Max Green Setting (Gmax), s	30.0	19.0	5.0	19.5
Max Q Clear Time (g_c+I1), s	21.3	5.9	3.6	16.4
Green Ext Time (p_c), s	5.8	0.4	0.0	2.0

Intersection Summary	
HCM 7th Control Delay, s/veh	19.7
HCM 7th LOS	B

Notes

User approved volume balancing among the lanes for turning movement.
Unsignalized Delay for [SBR] is excluded from calculations of the approach delay and intersection delay.

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	7:10	7:10	7:10	7:10	7:10	7:10
Total Time (min)	13	13	13	13	13	13
Time Recorded (min)	10	10	10	10	10	10
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	369	401	395	361	374	381
Vehs Exited	380	395	390	356	384	381
Starting Vehs	30	23	22	26	28	26
Ending Vehs	19	29	27	31	18	24
Travel Distance (mi)	85	90	90	83	87	87
Travel Time (hr)	3.7	4.0	4.1	3.8	3.8	3.9
Total Delay (hr)	0.2	0.3	0.3	0.3	0.2	0.3
Total Stops	45	53	60	63	49	54
Fuel Used (gal)	2.7	3.0	3.0	2.7	2.8	2.8

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:10
Total Time (min)	10

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	369	401	395	361	374	381
Vehs Exited	380	395	390	356	384	381
Starting Vehs	30	23	22	26	28	26
Ending Vehs	19	29	27	31	18	24
Travel Distance (mi)	85	90	90	83	87	87
Travel Time (hr)	3.7	4.0	4.1	3.8	3.8	3.9
Total Delay (hr)	0.2	0.3	0.3	0.3	0.2	0.3
Total Stops	45	53	60	63	49	54
Fuel Used (gal)	2.7	3.0	3.0	2.7	2.8	2.8

Intersection: 1: Castle Pines Pkwy & School Access

Movement	EB	EB	WB	WB	SB
Directions Served	L	T	T	R	R
Maximum Queue (ft)	56	18	4	14	92
Average Queue (ft)	38	4	1	3	51
95th Queue (ft)	61	32	8	20	102
Link Distance (ft)		846			667
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	165			150	
Storage Blk Time (%)					
Queuing Penalty (veh)					

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	7:10	7:10	7:10	7:10	7:10	7:10
Total Time (min)	13	13	13	13	13	13
Time Recorded (min)	10	10	10	10	10	10
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	347	389	380	381	357	371
Vehs Exited	355	392	377	385	368	375
Starting Vehs	29	21	21	25	27	25
Ending Vehs	21	18	24	21	16	19
Travel Distance (mi)	80	89	87	87	82	85
Travel Time (hr)	3.4	3.9	3.8	3.7	3.5	3.7
Total Delay (hr)	0.2	0.2	0.2	0.2	0.2	0.2
Total Stops	29	35	46	26	25	33
Fuel Used (gal)	2.5	2.9	2.8	2.7	2.5	2.7

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:10
Total Time (min)	10

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	347	389	380	381	357	371
Vehs Exited	355	392	377	385	368	375
Starting Vehs	29	21	21	25	27	25
Ending Vehs	21	18	24	21	16	19
Travel Distance (mi)	80	89	87	87	82	85
Travel Time (hr)	3.4	3.9	3.8	3.7	3.5	3.7
Total Delay (hr)	0.2	0.2	0.2	0.2	0.2	0.2
Total Stops	29	35	46	26	25	33
Fuel Used (gal)	2.5	2.9	2.8	2.7	2.5	2.7

Intersection: 1: Castle Pines Pkwy & School Access

Movement	EB	SB
Directions Served	L	R
Maximum Queue (ft)	35	67
Average Queue (ft)	18	36
95th Queue (ft)	45	69
Link Distance (ft)		685
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	165	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	7:10	7:10	7:10	7:10	7:10	7:10
Total Time (min)	13	13	13	13	13	13
Time Recorded (min)	10	10	10	10	10	10
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	369	402	392	399	374	386
Vehs Exited	380	396	394	403	385	392
Starting Vehs	30	23	23	26	28	26
Ending Vehs	19	29	21	22	17	22
Travel Distance (mi)	85	90	90	90	87	88
Travel Time (hr)	3.7	4.0	4.0	4.0	3.8	3.9
Total Delay (hr)	0.2	0.3	0.3	0.2	0.2	0.3
Total Stops	22	25	30	23	22	23
Fuel Used (gal)	2.7	3.0	3.0	2.9	2.8	2.9

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:10
Total Time (min)	10

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	369	402	392	399	374	386
Vehs Exited	380	396	394	403	385	392
Starting Vehs	30	23	23	26	28	26
Ending Vehs	19	29	21	22	17	22
Travel Distance (mi)	85	90	90	90	87	88
Travel Time (hr)	3.7	4.0	4.0	4.0	3.8	3.9
Total Delay (hr)	0.2	0.3	0.3	0.2	0.2	0.3
Total Stops	22	25	30	23	22	23
Fuel Used (gal)	2.7	3.0	3.0	2.9	2.8	2.9

Intersection: 1: Castle Pines Pkwy & School Access

Movement	EB	EB	WB	SB
Directions Served	L	T	T	R
Maximum Queue (ft)	53	16	8	26
Average Queue (ft)	36	3	2	8
95th Queue (ft)	60	30	11	36
Link Distance (ft)		858		667
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)	165			
Storage Blk Time (%)				
Queuing Penalty (veh)				

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	7:10	7:10	7:10	7:10	7:10	7:10
Total Time (min)	13	13	13	13	13	13
Time Recorded (min)	10	10	10	10	10	10
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	347	389	380	381	357	371
Vehs Exited	355	392	377	385	368	375
Starting Vehs	29	21	21	25	27	24
Ending Vehs	21	18	24	21	16	20
Travel Distance (mi)	79	89	87	86	82	85
Travel Time (hr)	3.4	3.9	3.8	3.7	3.5	3.7
Total Delay (hr)	0.2	0.2	0.2	0.2	0.2	0.2
Total Stops	14	13	28	15	11	16
Fuel Used (gal)	2.5	2.8	2.8	2.7	2.5	2.7

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:10
Total Time (min)	10

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	347	389	380	381	357	371
Vehs Exited	355	392	377	385	368	375
Starting Vehs	29	21	21	25	27	24
Ending Vehs	21	18	24	21	16	20
Travel Distance (mi)	79	89	87	86	82	85
Travel Time (hr)	3.4	3.9	3.8	3.7	3.5	3.7
Total Delay (hr)	0.2	0.2	0.2	0.2	0.2	0.2
Total Stops	14	13	28	15	11	16
Fuel Used (gal)	2.5	2.8	2.8	2.7	2.5	2.7

Intersection: 1: Castle Pines Pkwy & School Access

Movement	EB	SB
Directions Served	L	R
Maximum Queue (ft)	35	24
Average Queue (ft)	18	6
95th Queue (ft)	45	31
Link Distance (ft)		680
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	165	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Appendix B: Monarch Boulevard & Buffalo Trail Intersection Control Analysis

Intersection Control Analysis

To:	**City of Castle Pines**
From:	**Eli Farney, PE, PTOE**
Date:	**January 17, 2025**

Monarch Boulevard & Buffalo Trail Intersection

Castle Pines, Colorado

Prepared By:

J·R ENGINEERING

Eli Farney, PE, PTOE
efarney@jrengineering.com
JR Engineering
7200 South Alton Way, Suite C400
Centennial, CO 80112

Introduction

JR has conducted an intersection control analysis (ICA) at the intersection of Monarch Boulevard & Buffalo Trail in Castle Pines, Colorado. A vicinity map is included in **Figure 1**. The purpose of this letter is to analyze intersection control alternatives, including signalization, a roundabout, and a median acceleration lane. Since the peak hour and four-hour traffic signal warrants are not met, a full ICA was not completed. JR did not review construction costs, environmental impacts, utility impacts, or other components.

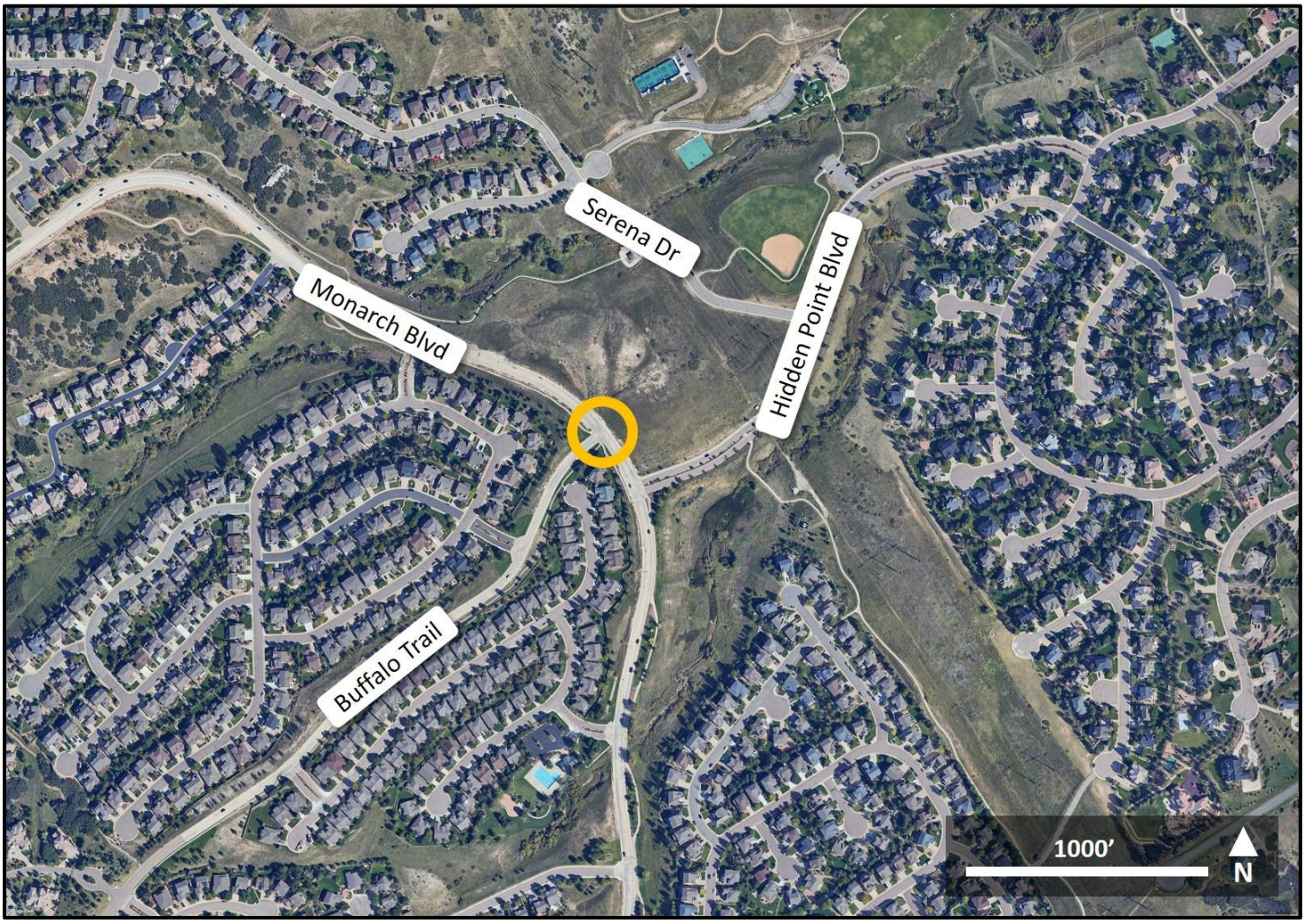


Figure 1: Vicinity Map

Existing Conditions

Existing Lane Geometry

The intersection of Monarch Boulevard & Buffalo Trail is currently stop-controlled. The northwest-bound approach of Monarch has separate left turn and through lanes. The southeast-bound approach of Monarch is a single lane for through and right turn movements. The northeast-bound approach of Buffalo, which is stop-controlled, is a single lane for left and right turns.

Existing Traffic Volumes

Traffic counts were collected on Tuesday, December 17, 2024 by All Traffic Data Services. Existing traffic volumes at the Monarch & Buffalo intersection are shown in **Figure 2**. Traffic counts are included in **Appendix A**.

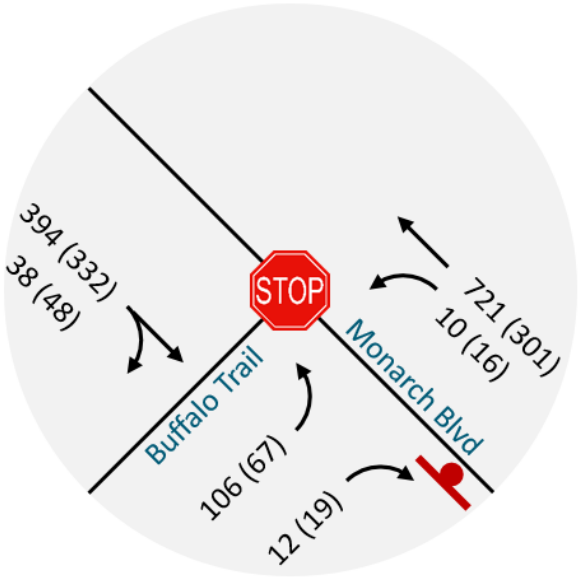


Figure 2: Monarch & Buffalo Existing Traffic Volumes

Traffic Signal Warrant Analysis

JR conducted a traffic signal warrant analysis based on the existing traffic volumes. Specifically, JR considered the peak hour and four-hour warrants in the MUTCD. Signal warrant reports are included in **Appendix B**.

The intersection of Monarch & Buffalo does not meet the peak hour or four-hour warrants due to low traffic volumes. Warrants may be met in the future as regional traffic volumes increase.

Intersection Control Alternatives

JR analyzed the intersection of Monarch Boulevard & Buffalo Trail with three alternatives: traffic signal, roundabout, and median acceleration lane. Details of each alternative are included below.

Traffic Signal

JR analyzed traffic operations with a traffic signal at the Monarch & Buffalo intersection. Existing lane geometry was assumed to remain. Signal timing was optimized with Synchro 12 software.

Roundabout

JR analyzed traffic operations with a single-lane roundabout at the Monarch & Buffalo intersection.

Median Acceleration Lane

JR analyzed traffic operations with a median acceleration lane for vehicles making a left turn from Buffalo Trail onto Monarch Boulevard.

Traffic Operations Analysis

Traffic operations were analyzed using *Highway Capacity Manual*, 7th Edition methodology. Synchro reports are included in **Appendix C**.

Traffic Operations

JR analyzed each of the Study intersections for peak hour level of service (LOS) and 95th percentile queue length. **Table 1** includes the LOS and queuing for each movement in the existing condition (year 2024) with stop control. **Table 2** includes the forecasted LOS and queuing for the three intersection control alternatives.

Table 1: 2024 Existing Traffic Operations

Intersection	Movement/Approach	AM Peak LOS	PM Peak LOS	AM Peak Queue (ft)	PM Peak Queue (ft)
Monarch Boulevard & Buffalo Trail	Northwest-Bound Left	A	A	<25	<25
	Northeast-Bound Approach	F	C	118	28

Table 2: Alternative Traffic Operations

Alternative	Movement/Approach	AM Peak LOS	PM Peak LOS	AM Peak Queue (ft)	PM Peak Queue (ft)
Traffic Signal	Northwest-Bound Left	A	A	<25	<25
	Northwest-Bound Through	A	A	294	80
	Southeast-Bound Approach	B	B	228	176
	Northeast-Bound Approach	B	B	70	49
Single-Lane Roundabout	Northwest-Bound Approach	B	A	150	25
	Southeast-Bound Approach	A	A	50	25
	Northeast-Bound Approach	A	A	25	<25
Median Acceleration Lane	Northwest-Bound Left	A	A	<25	<25
	Northeast-Bound Approach	C	B	53	<25

Discussion on Traffic Operations

In the existing condition, the northeast-bound approach fails in the AM peak hour. Levels of service for all other movements are acceptable. No issues with queuing are identified.

The traffic signal alternative is expected to maintain LOS B or better for all movements. However, queue lengths are expected to increase. As previously mentioned, the peak hour and four-hour signal warrants are not met.

The roundabout alternative is expected to maintain LOS B or better for all three approaches. Queue lengths are expected to be satisfactory.

The median acceleration lane is expected to improve the level of service and queuing for the northeast-bound approach on Buffalo Trail.

Recommendations

Interim Improvements

JR recommends striping a median acceleration lane as an interim improvement. The acceleration lane is expected to improve traffic operations for vehicles turning left from Buffalo Trail onto Monarch Boulevard.

Ultimate Improvements

JR recommends constructing a single-lane roundabout as an ultimate improvement. Levels of service and queue lengths are expected to be satisfactory on each leg of the intersection. The approximate size and placement of the roundabout is shown in **Figure 3** below. Right-of-way and property information is based on online mapping from Douglas County.

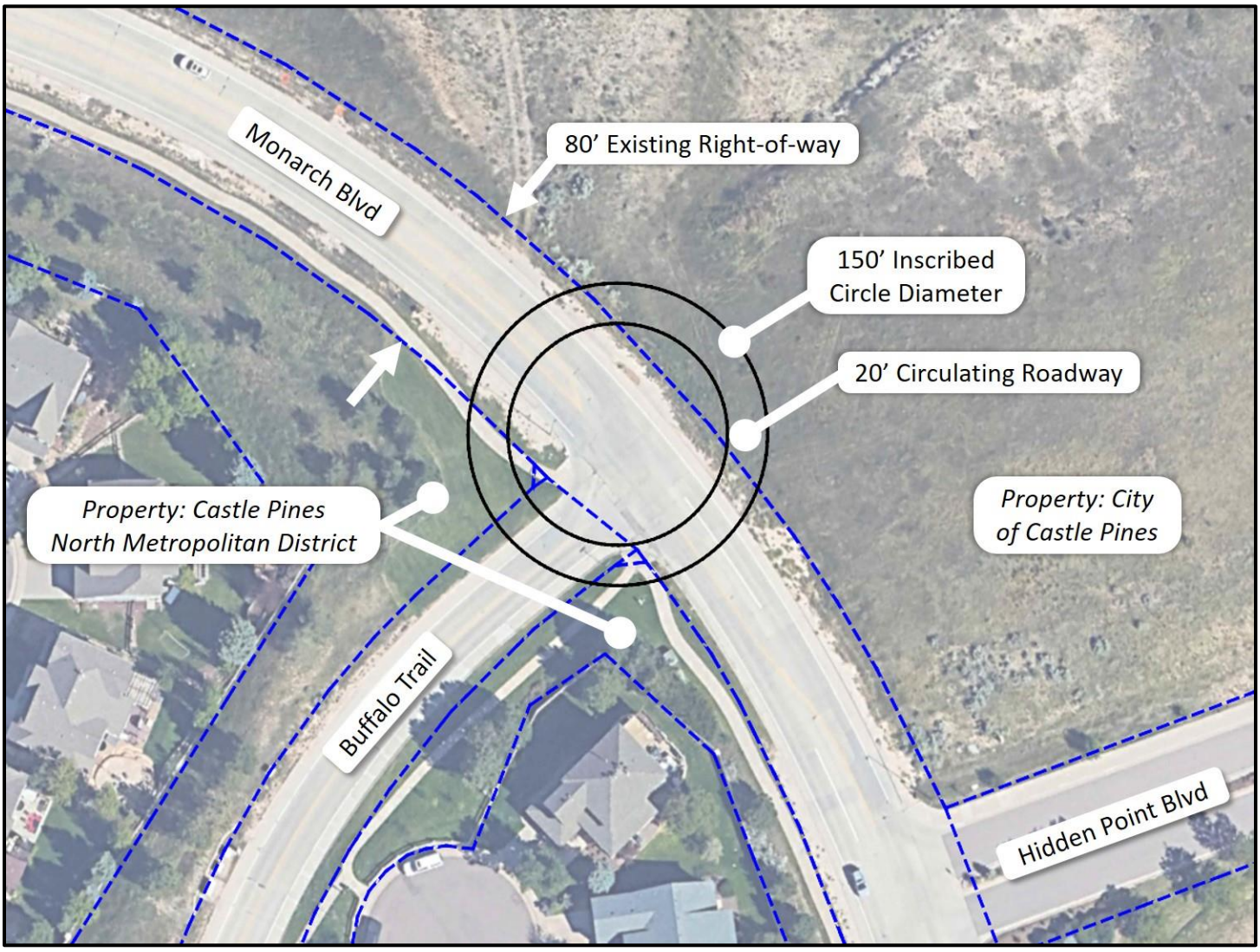


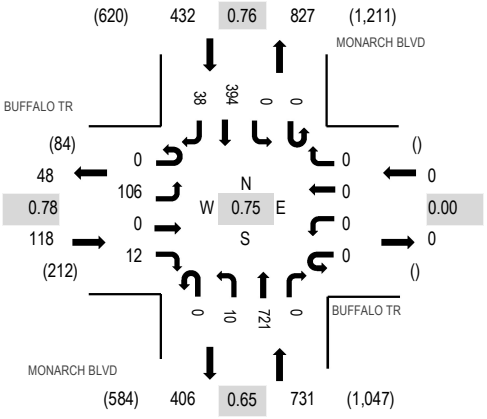
Figure 3: Roundabout Concept

Appendix A: Traffic Counts

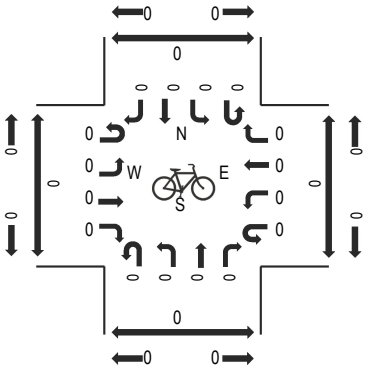
ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

Location: 1 MONARCH BLVD & BUFFALO TR AM
Date: Tuesday, December 17, 2024
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:15 AM - 07:30 AM

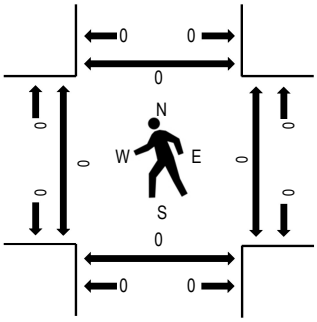
Peak Hour - Motorized Vehicles



Peak Hour - Bicycles



Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

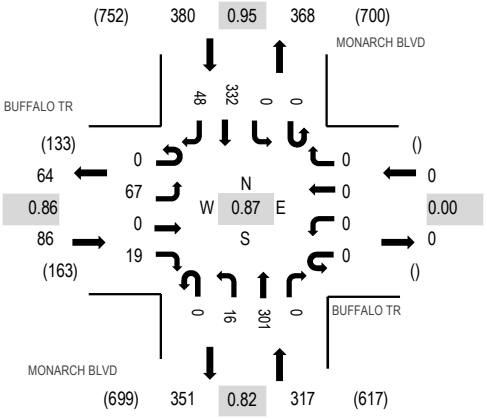
Traffic Counts - Motorized Vehicles

Interval Start Time	BUFFALO TR Eastbound				BUFFALO TR Westbound				MONARCH BLVD Northbound				MONARCH BLVD Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	28	0	3	0	0	0	0	0	1	280	0	0	0	63	3	378	1,281	0	0	0	0
7:15 AM	0	37	0	1	0	0	0	0	0	1	257	0	0	0	120	13	429	1,038	0	0	0	0
7:30 AM	0	21	0	5	0	0	0	0	0	4	107	0	0	0	135	7	279	764	0	0	0	0
7:45 AM	0	20	0	3	0	0	0	0	0	4	77	0	0	0	76	15	195	646	0	0	0	0
8:00 AM	0	15	0	4	0	0	0	0	0	4	61	0	0	0	45	6	135	598	2	0	0	0
8:15 AM	0	23	0	3	0	0	0	0	0	2	82	0	0	0	38	7	155		0	0	0	0
8:30 AM	0	26	0	6	0	0	0	0	0	2	79	0	0	0	42	6	161		1	0	0	0
8:45 AM	0	15	0	2	0	0	0	0	0	3	83	0	0	0	38	6	147		0	0	0	0
Count Total	0	185	0	27	0	0	0	0	0	21	1,026	0	0	0	557	63	1,879		3	0	0	0
Peak Hour	0	106	0	12	0	0	0	0	0	10	721	0	0	0	394	38	1,281		0	0	0	0

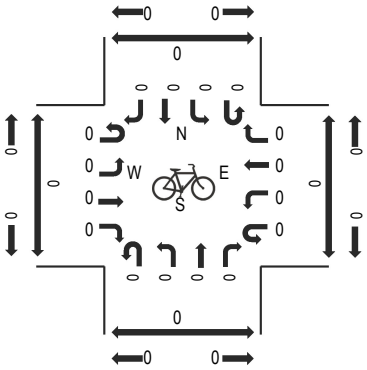
ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

Location: 1 MONARCH BLVD & BUFFALO TR PM
Date: Tuesday, December 17, 2024
Peak Hour: 05:00 PM - 06:00 PM
Peak 15-Minutes: 05:30 PM - 05:45 PM

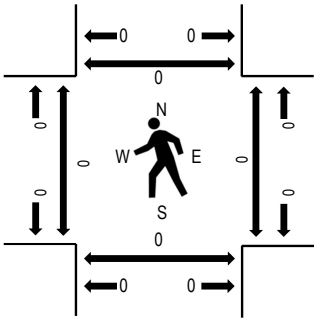
Peak Hour - Motorized Vehicles



Peak Hour - Bicycles



Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	BUFFALO TR Eastbound				BUFFALO TR Westbound				MONARCH BLVD Northbound				MONARCH BLVD Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
4:00 PM	0	7	0	6	0	0	0	0	0	3	78	0	0	0	95	15	204	749	0	0	0	0
4:15 PM	0	21	0	4	0	0	0	0	0	4	81	0	0	0	85	16	211	730	0	0	0	0
4:30 PM	0	16	0	12	0	0	0	0	0	3	57	0	0	0	84	10	182	709	0	0	1	0
4:45 PM	0	7	0	4	0	0	0	0	0	9	65	0	0	0	58	9	152	751	0	0	0	0
5:00 PM	0	13	0	5	0	0	0	0	0	5	72	0	0	0	76	14	185	783	0	0	0	0
5:15 PM	0	18	0	4	0	0	0	0	0	2	75	0	0	0	80	11	190		0	0	0	0
5:30 PM	0	20	0	5	0	0	0	0	0	6	94	0	0	0	86	13	224		0	0	0	0
5:45 PM	0	16	0	5	0	0	0	0	0	3	60	0	0	0	90	10	184		0	0	0	0
Count Total	0	118	0	45	0	0	0	0	0	35	582	0	0	0	654	98	1,532		0	0	1	0
Peak Hour	0	67	0	19	0	0	0	0	0	16	301	0	0	0	332	48	783		0	0	0	0

Appendix B: Signal Warrant Reports

Warrant 2: Four-hour Vehicular Volume

1: Monarch & Buffalo

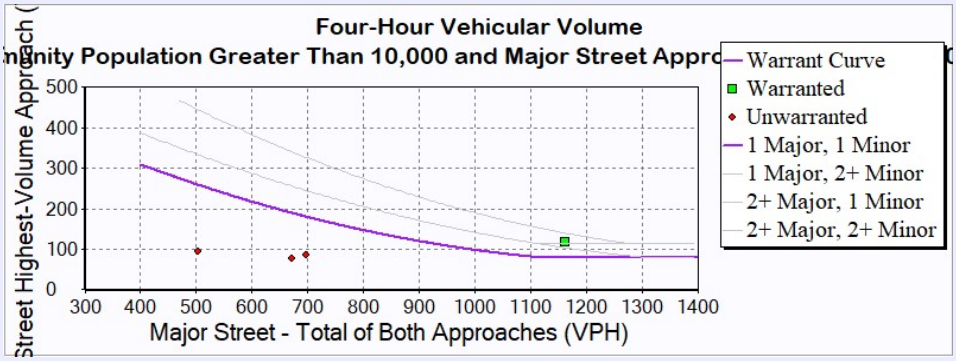
Intersection Information:

	Major Street	Minor Street
Street Name	Monarch Boulevard	Buffalo Trail
Direction	NB/SB	EB
Number of Lanes	1	1
Approach Speed	35	35

Warrant 2 Met? **No**

Details:

Notes	1 Hours met (4 required)
Low population?	No



Hourly Volumes

Hour	Major Street Total All Approaches (vph)	Minor Street Highest Volume Approach (vph)
00:00:00 - 01:00:00	0.00	0.00
01:00:00 - 02:00:00	0.00	0.00
02:00:00 - 03:00:00	0.00	0.00
03:00:00 - 04:00:00	0.00	0.00
04:00:00 - 05:00:00	0.00	0.00
05:00:00 - 06:00:00	0.00	0.00
06:00:00 - 07:00:00	0.00	0.00
07:00:00 - 08:00:00	1,163.00	118.00
08:00:00 - 09:00:00	504.00	94.00
09:00:00 - 10:00:00	0.00	0.00
10:00:00 - 11:00:00	0.00	0.00
11:00:00 - 12:00:00	0.00	0.00
12:00:00 - 13:00:00	0.00	0.00
13:00:00 - 14:00:00	0.00	0.00
14:00:00 - 15:00:00	0.00	0.00
15:00:00 - 16:00:00	0.00	0.00
16:00:00 - 17:00:00	672.00	77.00
17:00:00 - 18:00:00	697.00	86.00
18:00:00 - 19:00:00	0.00	0.00
19:00:00 - 20:00:00	0.00	0.00
20:00:00 - 21:00:00	0.00	0.00
21:00:00 - 22:00:00	0.00	0.00
22:00:00 - 23:00:00	0.00	0.00
23:00:00 - 00:00:00	0.00	0.00

Warranted Volumes

Hour	Major Street Total All Approaches (vph)	Minor Street Highest Volume Approach (vph)
07:00:00 - 08:00:00	1,163.00	118.00

Warrant 3: Peak Hour

1: Monarch & Buffalo

Intersection Information:

	Major Street	Minor Street
Street Name	Monarch Boulevard	Buffalo Trail
Direction	NB/SB	EB
Number of Lanes	1	1
Approach Speed	35	35

Warrant 3 Met? **No**

Details

Low Population? No

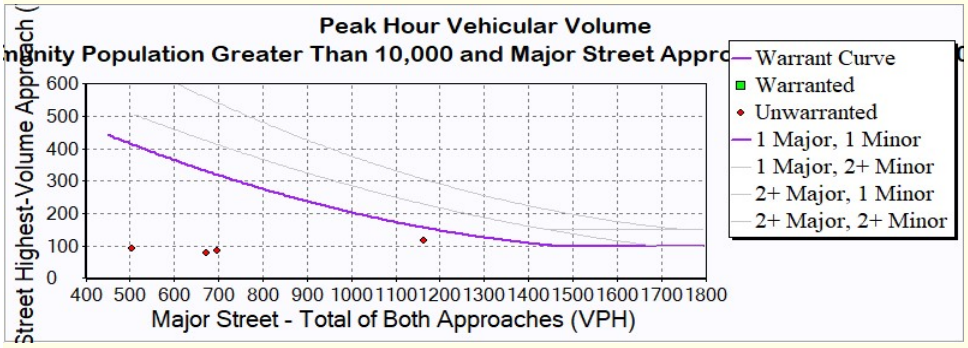
Condition A Met? No

Notes 0 Hours met (1 required)

Condition B Met? No

Notes 0 Hours met (1 required)

Minor Approach Time Delay Condition Met?	Not Met
Minor Approach Volume Condition Met?	Met
Total Entering Intersection Volume Condition Met?	Not Met



Hour	Major Street Total All Approaches (vph)	Minor Street Highest Volume Approach (vph)
7:00	1,163	118
8:00	504	94
16:00	672	77
17:00	697	86

Appendix C: Synchro Reports

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	394	38	10	721	106	12
Future Volume (vph)	394	38	10	721	106	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	70		0	0
Storage Lanes		0	1		1	0
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.986				0.986	
Flt Protected			0.950		0.957	
Satd. Flow (prot)	1837	0	1770	1863	1758	0
Flt Permitted			0.950		0.957	
Satd. Flow (perm)	1837	0	1770	1863	1758	0
Link Speed (mph)	35			35	35	
Link Distance (ft)	895			844	817	
Travel Time (s)	17.4			16.4	15.9	
Peak Hour Factor	0.90	0.78	0.78	0.92	0.83	0.78
Adj. Flow (vph)	438	49	13	784	128	15
Shared Lane Traffic (%)						
Lane Group Flow (vph)	487	0	13	784	143	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			12	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	6.1

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Vol, veh/h	394	38	10	721	106	12
Future Vol, veh/h	394	38	10	721	106	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	70	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	78	78	92	83	78
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	438	49	13	784	128	15

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	486	0	1271	462
Stage 1	-	-	-	-	462	-
Stage 2	-	-	-	-	809	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1076	-	185	600
Stage 1	-	-	-	-	634	-
Stage 2	-	-	-	-	438	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1076	-	183	600
Mov Cap-2 Maneuver	-	-	-	-	183	-
Stage 1	-	-	-	-	634	-
Stage 2	-	-	-	-	433	-

Approach	SE	NW	NE
HCM Control Delay, s/v	0	0.13	60.03
HCM LOS			F

Minor Lane/Major Mvmt	NELn1	NWL	NWT	SET	SER
Capacity (veh/h)	198	1076	-	-	-
HCM Lane V/C Ratio	0.724	0.012	-	-	-
HCM Control Delay (s/veh)	60	8.4	-	-	-
HCM Lane LOS	F	A	-	-	-
HCM 95th %tile Q(veh)	4.7	0	-	-	-

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	332	48	16	301	67	19
Future Volume (vph)	332	48	16	301	67	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	70		0	0
Storage Lanes		0	1		1	0
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.981				0.970	
Flt Protected			0.950		0.963	
Satd. Flow (prot)	1827	0	1770	1863	1740	0
Flt Permitted			0.950		0.963	
Satd. Flow (perm)	1827	0	1770	1863	1740	0
Link Speed (mph)	35			35	35	
Link Distance (ft)	895			844	817	
Travel Time (s)	17.4			16.4	15.9	
Peak Hour Factor	0.89	0.78	0.78	0.89	0.80	0.78
Adj. Flow (vph)	373	62	21	338	84	24
Shared Lane Traffic (%)						
Lane Group Flow (vph)	435	0	21	338	108	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			12	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	2.3

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Vol, veh/h	332	48	16	301	67	19
Future Vol, veh/h	332	48	16	301	67	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	70	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	89	78	78	89	80	78
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	373	62	21	338	84	24

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	435	0	783	404
Stage 1	-	-	-	-	404	-
Stage 2	-	-	-	-	379	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1125	-	362	647
Stage 1	-	-	-	-	674	-
Stage 2	-	-	-	-	692	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1125	-	356	647
Mov Cap-2 Maneuver	-	-	-	-	356	-
Stage 1	-	-	-	-	674	-
Stage 2	-	-	-	-	679	-

Approach	SE	NW	NE
HCM Control Delay, s/v	0	0.47	17.47
HCM LOS			C

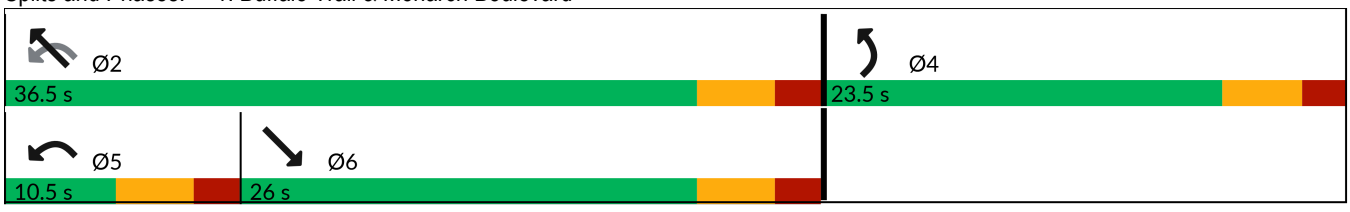
Minor Lane/Major Mvmt	NELn1	NWL	NWT	SET	SER
Capacity (veh/h)	396	1125	-	-	-
HCM Lane V/C Ratio	0.273	0.018	-	-	-
HCM Control Delay (s/veh)	17.5	8.3	-	-	-
HCM Lane LOS	C	A	-	-	-
HCM 95th %tile Q(veh)	1.1	0.1	-	-	-

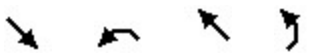
Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	394	38	10	721	106	12
Future Volume (vph)	394	38	10	721	106	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	70		0	0
Storage Lanes		0	1		1	0
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.986				0.986	
Flt Protected			0.950		0.957	
Satd. Flow (prot)	1837	0	1770	1863	1758	0
Flt Permitted			0.358		0.957	
Satd. Flow (perm)	1837	0	667	1863	1758	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	10				10	
Link Speed (mph)	35			35	35	
Link Distance (ft)	895			844	817	
Travel Time (s)	17.4			16.4	15.9	
Peak Hour Factor	0.90	0.78	0.78	0.92	0.83	0.78
Adj. Flow (vph)	438	49	13	784	128	15
Shared Lane Traffic (%)						
Lane Group Flow (vph)	487	0	13	784	143	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			12	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Number of Detectors	2		1	2	1	
Detector Template	Thru		Left	Thru	Left	
Leading Detector (ft)	100		20	100	20	
Trailing Detector (ft)	0		0	0	0	
Detector 1 Position(ft)	0		0	0	0	
Detector 1 Size(ft)	6		20	6	20	
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0		0.0	0.0	0.0	
Detector 1 Queue (s)	0.0		0.0	0.0	0.0	
Detector 1 Delay (s)	0.0		0.0	0.0	0.0	
Detector 2 Position(ft)	94			94		
Detector 2 Size(ft)	6			6		
Detector 2 Type	Cl+Ex			Cl+Ex		
Detector 2 Channel						
Detector 2 Extend (s)	0.0			0.0		
Turn Type	NA		pm+pt	NA	Prot	
Protected Phases	6		5	2	4	
Permitted Phases			2			

Lane Group	SET	SER	NWL	NWT	NEL	NER
Detector Phase	6		5	2	4	
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	
Minimum Split (s)	23.5		10.5	23.5	23.5	
Total Split (s)	26.0		10.5	36.5	23.5	
Total Split (%)	43.3%		17.5%	60.8%	39.2%	
Maximum Green (s)	20.5		5.0	31.0	18.0	
Yellow Time (s)	3.5		3.5	3.5	3.5	
All-Red Time (s)	2.0		2.0	2.0	2.0	
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	
Total Lost Time (s)	5.5		5.5	5.5	5.5	
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	Min		None	Min	None	
Walk Time (s)	7.0			7.0	7.0	
Flash Don't Walk (s)	11.0			11.0	11.0	
Pedestrian Calls (#/hr)	0			0	0	
Act Effct Green (s)	31.3		31.4	33.2	9.4	
Actuated g/C Ratio	0.64		0.64	0.68	0.19	
v/c Ratio	0.41		0.02	0.62	0.41	
Control Delay (s/veh)	9.9		5.0	10.2	21.5	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay (s/veh)	9.9		5.0	10.2	21.5	
LOS	A		A	B	C	
Approach Delay (s/veh)	9.9			10.1	21.5	
Approach LOS	A			B	C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 48.8			
Natural Cycle: 60			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.62			
Intersection Signal Delay (s/veh): 11.2		Intersection LOS: B	
Intersection Capacity Utilization 53.7%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 1: Buffalo Trail & Monarch Boulevard





Lane Group	SET	NWL	NWT	NEL
Lane Group Flow (vph)	487	13	784	143
v/c Ratio	0.41	0.02	0.62	0.41
Control Delay (s/veh)	9.9	5.0	10.2	21.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay (s/veh)	9.9	5.0	10.2	21.5
Queue Length 50th (ft)	65	1	138	36
Queue Length 95th (ft)	#228	6	294	70
Internal Link Dist (ft)	815		764	737
Turn Bay Length (ft)		70		
Base Capacity (vph)	1183	548	1269	688
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.41	0.02	0.62	0.21

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	394	38	10	721	106	12
Future Volume (veh/h)	394	38	10	721	106	12
Initial Q (Qb), veh	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	438	49	13	784	128	15
Peak Hour Factor	0.90	0.78	0.78	0.92	0.83	0.78
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	602	67	374	1029	175	20
Arrive On Green	0.36	0.36	0.02	0.55	0.11	0.11
Sat Flow, veh/h	1652	185	1781	1870	1564	183
Grp Volume(v), veh/h	0	487	13	784	144	0
Grp Sat Flow(s),veh/h/ln	0	1837	1781	1870	1759	0
Q Serve(g_s), s	0.0	7.5	0.1	10.6	2.6	0.0
Cycle Q Clear(g_c), s	0.0	7.5	0.1	10.6	2.6	0.0
Prop In Lane		0.10	1.00		0.89	0.10
Lane Grp Cap(c), veh/h	0	670	374	1029	197	0
V/C Ratio(X)	0.00	0.73	0.03	0.76	0.73	0.00
Avail Cap(c_a), veh/h	0	1157	618	1781	972	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	0.0	8.9	6.5	5.7	14.0	0.0
Incr Delay (d2), s/veh	0.0	1.5	0.0	1.2	5.2	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	2.0	0.0	1.6	1.1	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d), s/veh	0.0	10.5	6.5	6.9	19.2	0.0
LnGrp LOS		B	A	A	B	
Approach Vol, veh/h	487			797	144	
Approach Delay, s/veh	10.5			6.9	19.2	
Approach LOS	B			A	B	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		23.4		9.1	6.1	17.4
Change Period (Y+Rc), s		5.5		5.5	5.5	5.5
Max Green Setting (Gmax), s		31.0		18.0	5.0	20.5
Max Q Clear Time (g_c+I1), s		12.6		4.6	2.1	9.5
Green Ext Time (p_c), s		5.4		0.3	0.0	2.3

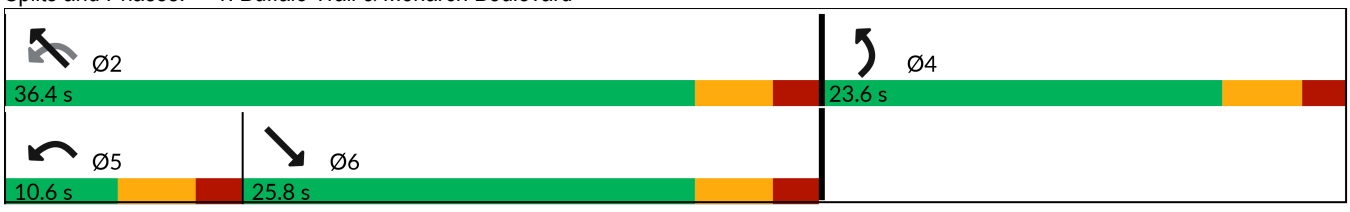
Intersection Summary	
HCM 7th Control Delay, s/veh	9.3
HCM 7th LOS	A

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	332	48	16	301	67	19
Future Volume (vph)	332	48	16	301	67	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	70		0	0
Storage Lanes		0	1		1	0
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.981				0.970	
Flt Protected			0.950		0.963	
Satd. Flow (prot)	1827	0	1770	1863	1740	0
Flt Permitted			0.373		0.963	
Satd. Flow (perm)	1827	0	695	1863	1740	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	15				24	
Link Speed (mph)	35			35	35	
Link Distance (ft)	895			844	817	
Travel Time (s)	17.4			16.4	15.9	
Peak Hour Factor	0.89	0.78	0.78	0.89	0.80	0.78
Adj. Flow (vph)	373	62	21	338	84	24
Shared Lane Traffic (%)						
Lane Group Flow (vph)	435	0	21	338	108	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			12	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Number of Detectors	2		1	2	1	
Detector Template	Thru		Left	Thru	Left	
Leading Detector (ft)	100		20	100	20	
Trailing Detector (ft)	0		0	0	0	
Detector 1 Position(ft)	0		0	0	0	
Detector 1 Size(ft)	6		20	6	20	
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0		0.0	0.0	0.0	
Detector 1 Queue (s)	0.0		0.0	0.0	0.0	
Detector 1 Delay (s)	0.0		0.0	0.0	0.0	
Detector 2 Position(ft)	94			94		
Detector 2 Size(ft)	6			6		
Detector 2 Type	Cl+Ex			Cl+Ex		
Detector 2 Channel						
Detector 2 Extend (s)	0.0			0.0		
Turn Type	NA		pm+pt	NA	Prot	
Protected Phases	6		5	2	4	
Permitted Phases			2			

Lane Group	SET	SER	NWL	NWT	NEL	NER
Detector Phase	6		5	2	4	
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	
Minimum Split (s)	23.5		10.5	23.5	23.5	
Total Split (s)	25.8		10.6	36.4	23.6	
Total Split (%)	43.0%		17.7%	60.7%	39.3%	
Maximum Green (s)	20.3		5.1	30.9	18.1	
Yellow Time (s)	3.5		3.5	3.5	3.5	
All-Red Time (s)	2.0		2.0	2.0	2.0	
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	
Total Lost Time (s)	5.5		5.5	5.5	5.5	
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	Min		None	Min	None	
Walk Time (s)	7.0			7.0	7.0	
Flash Don't Walk (s)	11.0			11.0	11.0	
Pedestrian Calls (#/hr)	0			0	0	
Act Effct Green (s)	24.0		24.0	25.6	7.8	
Actuated g/C Ratio	0.60		0.60	0.64	0.19	
v/c Ratio	0.40		0.04	0.28	0.30	
Control Delay (s/veh)	9.1		4.9	6.0	15.1	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay (s/veh)	9.1		4.9	6.0	15.1	
LOS	A		A	A	B	
Approach Delay (s/veh)	9.1			5.9	15.1	
Approach LOS	A			A	B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 40.1			
Natural Cycle: 60			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.40			
Intersection Signal Delay (s/veh): 8.6		Intersection LOS: A	
Intersection Capacity Utilization 34.4%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 1: Buffalo Trail & Monarch Boulevard



Lane Group	SET	NWL	NWT	NEL
Lane Group Flow (vph)	435	21	338	108
v/c Ratio	0.40	0.04	0.28	0.30
Control Delay (s/veh)	9.1	4.9	6.0	15.1
Queue Delay	0.0	0.0	0.0	0.0
Total Delay (s/veh)	9.1	4.9	6.0	15.1
Queue Length 50th (ft)	48	2	36	16
Queue Length 95th (ft)	176	8	80	49
Internal Link Dist (ft)	815		764	737
Turn Bay Length (ft)		70		
Base Capacity (vph)	1117	559	1452	834
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.39	0.04	0.23	0.13

Intersection Summary

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	332	48	16	301	67	19
Future Volume (veh/h)	332	48	16	301	67	19
Initial Q (Qb), veh	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	373	62	21	338	84	24
Peak Hour Factor	0.89	0.78	0.78	0.89	0.80	0.78
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	530	88	407	1018	132	38
Arrive On Green	0.34	0.34	0.03	0.54	0.10	0.10
Sat Flow, veh/h	1564	260	1781	1870	1337	382
Grp Volume(v), veh/h	0	435	21	338	109	0
Grp Sat Flow(s),veh/h/ln	0	1824	1781	1870	1735	0
Q Serve(g_s), s	0.0	6.4	0.2	3.1	1.9	0.0
Cycle Q Clear(g_c), s	0.0	6.4	0.2	3.1	1.9	0.0
Prop In Lane		0.14	1.00		0.77	0.22
Lane Grp Cap(c), veh/h	0	618	407	1018	171	0
V/C Ratio(X)	0.00	0.70	0.05	0.33	0.64	0.00
Avail Cap(c_a), veh/h	0	1202	655	1877	1020	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	0.0	8.8	6.2	3.9	13.4	0.0
Incr Delay (d2), s/veh	0.0	1.5	0.1	0.2	3.9	0.0
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	1.7	0.0	0.4	0.7	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d), s/veh	0.0	10.3	6.3	4.1	17.3	0.0
LnGrp LOS		B	A	A	B	
Approach Vol, veh/h	435			359	109	
Approach Delay, s/veh	10.3			4.2	17.3	
Approach LOS	B			A	B	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		22.3		8.5	6.3	15.9
Change Period (Y+Rc), s		5.5		5.5	5.5	5.5
Max Green Setting (Gmax), s		30.9		18.1	5.1	20.3
Max Q Clear Time (g_c+I1), s		5.1		3.9	2.2	8.4
Green Ext Time (p_c), s		2.0		0.2	0.0	2.1

Intersection Summary	
HCM 7th Control Delay, s/veh	8.7
HCM 7th LOS	A

Notes

User approved pedestrian interval to be less than phase max green.

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	394	38	10	721	106	12
Future Volume (vph)	394	38	10	721	106	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.986				0.986	
Flt Protected				0.999	0.957	
Satd. Flow (prot)	1837	0	0	1861	1758	0
Flt Permitted				0.999	0.957	
Satd. Flow (perm)	1837	0	0	1861	1758	0
Link Speed (mph)	35			35	35	
Link Distance (ft)	895			844	817	
Travel Time (s)	17.4			16.4	15.9	
Peak Hour Factor	0.90	0.78	0.78	0.92	0.83	0.78
Adj. Flow (vph)	438	49	13	784	128	15
Shared Lane Traffic (%)						
Lane Group Flow (vph)	487	0	0	797	143	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Yield			Yield	Yield	

Intersection Summary			
Area Type:	Other		
Control Type: Roundabout			
Intersection Capacity Utilization	59.2%	ICU Level of Service	B
Analysis Period (min)	15		

Intersection	
Intersection Delay, s/veh	9.6
Intersection LOS	A

Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	487	797	143
Demand Flow Rate, veh/h	497	813	146
Vehicles Circulating, veh/h	13	131	447
Vehicles Exiting, veh/h	931	462	63
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.1	12.4	5.9
Approach LOS	A	B	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
A (Intercept)	1380	1380	1380
B (Slope)	1.02e-3	1.02e-3	1.02e-3
Entry Flow, veh/h	497	813	146
Cap Entry Lane, veh/h	1362	1207	875
Entry HV Adj Factor	0.980	0.981	0.979
Flow Entry, veh/h	487	797	143
Cap Entry, veh/h	1335	1184	857
V/C Ratio	0.365	0.673	0.167
Control Delay, s/veh	6.1	12.4	5.9
LOS	A	B	A
95th %tile Queue, veh	2	6	1

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	332	48	16	301	67	19
Future Volume (vph)	332	48	16	301	67	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.981				0.970	
Flt Protected				0.997	0.963	
Satd. Flow (prot)	1827	0	0	1857	1740	0
Flt Permitted				0.997	0.963	
Satd. Flow (perm)	1827	0	0	1857	1740	0
Link Speed (mph)	35			35	35	
Link Distance (ft)	895			844	817	
Travel Time (s)	17.4			16.4	15.9	
Peak Hour Factor	0.89	0.78	0.78	0.89	0.80	0.78
Adj. Flow (vph)	373	62	21	338	84	24
Shared Lane Traffic (%)						
Lane Group Flow (vph)	435	0	0	359	108	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Yield			Yield	Yield	

Intersection Summary			
Area Type:	Other		
Control Type: Roundabout			
Intersection Capacity Utilization	40.4%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Intersection Delay, s/veh	5.5
Intersection LOS	A

Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	435	359	108
Demand Flow Rate, veh/h	443	366	110
Vehicles Circulating, veh/h	21	86	380
Vehicles Exiting, veh/h	431	404	84
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.7	5.5	5.0
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
A (Intercept)	1380	1380	1380
B (Slope)	1.02e-3	1.02e-3	1.02e-3
Entry Flow, veh/h	443	366	110
Cap Entry Lane, veh/h	1351	1264	937
Entry HV Adj Factor	0.981	0.982	0.982
Flow Entry, veh/h	435	359	108
Cap Entry, veh/h	1325	1241	919
V/C Ratio	0.328	0.290	0.117
Control Delay, s/veh	5.7	5.5	5.0
LOS	A	A	A
95th %tile Queue, veh	1	1	0

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	394	38	10	721	106	12
Future Volume (vph)	394	38	10	721	106	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	70		0	0
Storage Lanes		0	1		1	0
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.986				0.986	
Flt Protected			0.950		0.957	
Satd. Flow (prot)	1837	0	1770	1863	1758	0
Flt Permitted			0.950		0.957	
Satd. Flow (perm)	1837	0	1770	1863	1758	0
Link Speed (mph)	35			35	35	
Link Distance (ft)	895			844	817	
Travel Time (s)	17.4			16.4	15.9	
Peak Hour Factor	0.90	0.78	0.78	0.92	0.83	0.78
Adj. Flow (vph)	438	49	13	784	128	15
Shared Lane Traffic (%)						
Lane Group Flow (vph)	487	0	13	784	143	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			12	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	2.5

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Vol, veh/h	394	38	10	721	106	12
Future Vol, veh/h	394	38	10	721	106	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	70	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	78	78	92	83	78
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	438	49	13	784	128	15

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	486	0	1271	462
Stage 1	-	-	-	-	462	-
Stage 2	-	-	-	-	809	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1076	-	185	600
Stage 1	-	-	-	-	634	-
Stage 2	-	-	-	-	438	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1076	-	183	600
Mov Cap-2 Maneuver	-	-	-	-	314	-
Stage 1	-	-	-	-	634	-
Stage 2	-	-	-	-	433	-

Approach	SE	NW	NE
HCM Control Delay, s/v	0	0.13	23.94
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NWL	NWT	SET	SER
Capacity (veh/h)	331	1076	-	-	-
HCM Lane V/C Ratio	0.433	0.012	-	-	-
HCM Control Delay (s/veh)	23.9	8.4	-	-	-
HCM Lane LOS	C	A	-	-	-
HCM 95th %tile Q(veh)	2.1	0	-	-	-

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	332	48	16	301	67	19
Future Volume (vph)	332	48	16	301	67	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	70		0	0
Storage Lanes		0	1		1	0
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.981				0.970	
Flt Protected			0.950		0.963	
Satd. Flow (prot)	1827	0	1770	1863	1740	0
Flt Permitted			0.950		0.963	
Satd. Flow (perm)	1827	0	1770	1863	1740	0
Link Speed (mph)	35			35	35	
Link Distance (ft)	895			844	817	
Travel Time (s)	17.4			16.4	15.9	
Peak Hour Factor	0.89	0.78	0.78	0.89	0.80	0.78
Adj. Flow (vph)	373	62	21	338	84	24
Shared Lane Traffic (%)						
Lane Group Flow (vph)	435	0	21	338	108	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			12	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	1.9

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Vol, veh/h	332	48	16	301	67	19
Future Vol, veh/h	332	48	16	301	67	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	70	-	0	-
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	89	78	78	89	80	78
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	373	62	21	338	84	24

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	435	0	783	404
Stage 1	-	-	-	-	404	-
Stage 2	-	-	-	-	379	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1125	-	362	647
Stage 1	-	-	-	-	674	-
Stage 2	-	-	-	-	692	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1125	-	356	647
Mov Cap-2 Maneuver	-	-	-	-	471	-
Stage 1	-	-	-	-	674	-
Stage 2	-	-	-	-	679	-

Approach	SE	NW	NE
HCM Control Delay, s/v	0	0.47	14.13
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NWL	NWT	SET	SER
Capacity (veh/h)	502	1125	-	-	-
HCM Lane V/C Ratio	0.215	0.018	-	-	-
HCM Control Delay (s/veh)	14.1	8.3	-	-	-
HCM Lane LOS	B	A	-	-	-
HCM 95th %tile Q(veh)	0.8	0.1	-	-	-