2019

Louisville South Boulder Road

CONNECTIVITY PLAN

CITY OF LOUISVILLE | FEHR & PEERS | RUSSELL + MILLS STUDIO

March 2019

FEHR PEERS

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Introduction

The Louisville South Boulder Road Connectivity Plan summarizes analysis and recommendations for improving the safety, comfort, and convenience of people walking, rolling, or bicycling across a one-mile segment of South Boulder Road in the City of Louisville, Colorado.

The project is part of a one-year planning and conceptual design effort that analyzed and proposed grade-separated crossings at three locations, as well as at-grade crossing improvements at five intersections along South Boulder Road between Main Street and Eisenhower Drive.

South Boulder Road is locally significant as a key connection for people walking, bicycling, and driving to many destinations, and regionally significant as a busy east-west commuting corridor between Boulder and communities to the east. The objective of this planning initiative was to provide recommendations that improve mobility across South Boulder Road, while aligning with the long-standing desires shared by community members and local elected officials for such improvements.

This plan details the analysis and recommendations for prioritized grade-separated and at-grade crossing improvements, as well as the conceptual designs, estimated costs, and potential benefits of implementing these projects. Transportation project-specific funding sources are also identified for current or future implementation efforts. Additional project background including detailed cost estimates and the existing conditions analysis completed in September 2018 is included in the Appendix.

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The Plan for South Boulder Road

The plan for enhanced crossings that accommodate people of all ages and abilities along South Boulder Road includes both recommended short-term at-grade improvements within five intersections, and near- or long-term grade-separated undercrossing projects at three locations.

The projects were prioritized based upon research of previous planning efforts undertaken by the City, direction from the City Council, analysis of traffic and crash data, assessment of pedestrian and bicyclist flows across the roadway, and consideration of important multimodal connections such as off-street trails or key destinations along the corridor. The final alternatives represent proposed solutions that will create a safer South Boulder Road for people walking, bicycling, and driving, as well as build a more inviting space and enhanced community asset for the City of Louisville.

Figure 1 illustrates the proposed project locations, with each described below in order of priority.

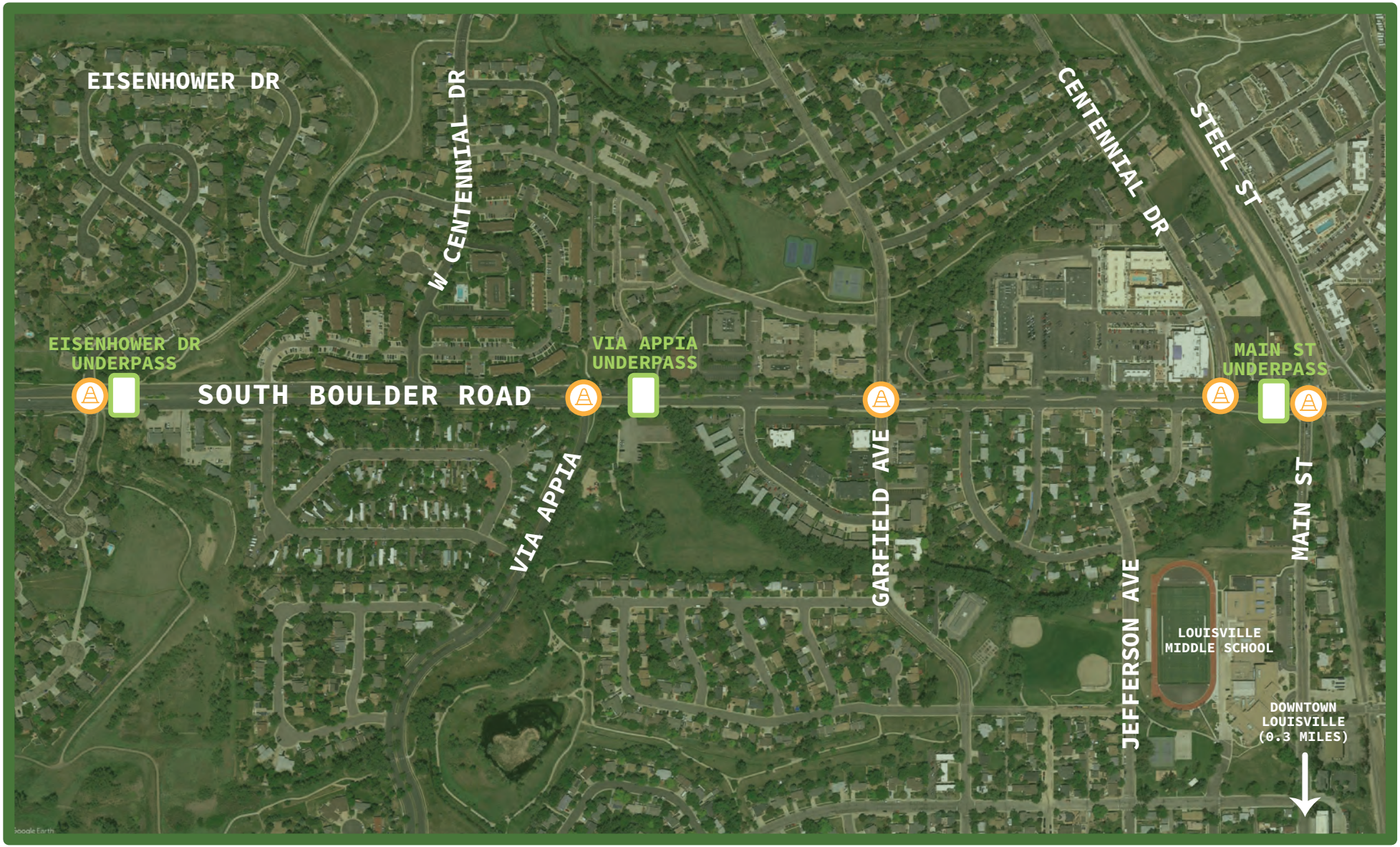

Figure 1: Proposed Project Locations

Proposed Undercrossing

Proposed At-Grade Crossing Improvement

MAIN STREET UNDERCROSSING

A proposed grade-separated crossing that would travel underneath South Boulder Road immediately west of the Main Street intersection. The undercrossing would provide a safe and comfortable connection for people walking, rolling, or bicycling to downtown Louisville, Louisville Middle School, and local destinations along the corridor. The Main Street grade-separated crossing has been identified as a priority by the community and elected officials in previous city-led planning efforts.

AT-GRADE CROSSING IMPROVEMENTS

Signal operations and geometric infrastructure improvements are recommended at the following intersections:

1. Main Street
2. Centennial Drive
3. Garfield Avenue
4. Via Appia
5. Eisenhower Drive

The at-grade improvements will provide short-term safety enhancements for people walking, bicycling, and driving on South Boulder Road. At-grade project items were identified as a part of analyzing the corridor's traffic operations, crash history, and existing infrastructure. Proposed improvements include curb and median extensions to shorten crossing distance, the addition of protected left-turns at Main Street, Garfield Avenue, and Via Appia, and construction of a Pedestrian Hybrid Beacon at Eisenhower Drive.

VIA APPIA AND EISENHOWER DRIVE UNDERCROSSINGS

Two other locations for potential grade-separation in the long-term were identified per previous community input and existing off-street trail connections. Both locations will benefit in the short-term from proposed at-grade crossing solutions until demand warrants such improvement and funding becomes available. The completion of these two underpasses would create grade-separated crossings spaced at approximate half-mile increments along the corridor between Main Street and the existing undercrossing immediately west of Washington Avenue.


S Boulder
SEPTEMBER 14
12pm - 4pm
Community Park

07

How We Got Here

PLAN BACKGROUND

The plan stems from ongoing community concern regarding the safety and experience of crossing South Boulder Road, as well as the quality of the walking and biking environment along this major arterial. Existing infrastructure quality and community input have been gathered through previous planning efforts including the *South Boulder Road Small Area Plan (2016)* and forthcoming Transportation Master Plan.

The community has identified the corridor as a local asset that needs improved accessibility, crossings, and slowed speeds to promote a more inviting atmosphere for people walking and bicycling. Access to key destinations along South Boulder Road between SH 42 and Eisenhower Drive, which recorded 26,000 daily vehicles in 2016 within that area, currently requires crossing at-grade.[1] These destinations include retail and commercial nodes, denser housing, parks and schools, and downtown Louisville. The nearby Louisville Middle School attracts many children across South Boulder Road at Main Street and Centennial Drive, while downtown Louisville draws residents including those that live to the north of the corridor and many visitors during special events.

South Boulder Road is a major arterial carrying numerous people across various modes of transportation. As Louisville continues to grow, and residents or visitors consider other means of travel such as walking, rolling, or bicycling, a greater need toward balancing the different modes of transportation that use the corridor has formed. Due to this, tradeoffs between vehicular traffic that use South Boulder Road for regional mobility, and those in the local community who may be accessing corridor destinations via alternative modes, were measured and analyzed to develop balanced recommendations. Proposed improvements provide mobility for all with at-grade and grade-separated crossing options that are safe, comfortable, and accessible.

At-grade crossing improvements could be implemented in the short-term to provide the public with visible, expeditious crossing enhancements. Concurrently, securing funding and proceeding with design of a grade-separated undercrossing at Main Street will ensure the crossing is constructed in the near-term to serve existing and future demand at that location. Other potential grade-separated undercrossings at Via Appia or Eisenhower Drive should be considered in the long-term only as demand requires or funding becomes available following the implementation of other transportation priorities in Louisville.

[1] DRCOG Traffic Counts, May 2016.

PLANNING PROCESS

The planning process underwent four steps that led to recommendations for at-grade and grade-separated crossing improvements along South Boulder Road between Main Street and Eisenhower Drive.

1

EXISTING CONDITIONS ANALYSIS

The first step of the planning process included addressing perceived pedestrian and bicycle flows across South Boulder Road, as well as analyzing the corridor's crash history and existing traffic conditions. Field observations were conducted during weekday morning and afternoon peak hours, and during a special event, to form a baseline for comparison between existing conditions and study alternatives.

2

CROSSING ALTERNATIVES DEVELOPMENT

Grade-separated crossing alternatives both over and under South Boulder Road were developed at locations which aligned with the north-south pedestrian and bicycle flows previously identified. Traffic impacts were also reviewed for at-grade crossing improvement alternatives that varied in their effects on vehicular flows.

3

CROSSING ALTERNATIVES ANALYSIS

Following a high-level analysis, grade-separated alternatives at Main Street, Via Appia, and Eisenhower Drive were conceptually designed and reviewed. At-grade crossing options were further studied using traffic simulation analysis to understand potential traffic and travel time implications, and refined per additional infrastructure analysis.

4

PROPOSED CROSSING IMPROVEMENTS

Grade-separated and at-grade crossing options were further refined in concept and design for recommended future improvements along South Boulder Road. An undercrossing at Main Street is proposed as the highest-priority, with potential undercrossings at Via Appia and Eisenhower Drive illustrated in concept. Final concepts of at-grade crossing improvements are included and illustrate those that balanced the corridor's regional vehicular travel with safety improvements for people walking and bicycling.

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Main Street Undercrossing

BACKGROUND

A grade-separated crossing at Main Street has been desired by the community as illustrated in feedback received through previous planning efforts and the City Council. The existing at-grade crossing is well-used by students walking, rolling, or bicycling to nearby Louisville Middle School, as well as resident traveling to downtown Louisville or other destinations along South Boulder Road. Main Street serves the highest crossing demand as compared to the other locations considered for a grade-separated crossing within the one-mile study area. Demand will likely continue to increase as other destinations, housing, and commercial uses are constructed nearby as envisioned in the *South Boulder Road Small Area Plan (2016)*. Connecting these current and future destinations to the historic core of Louisville will provide residents and visitors a safe and comfortable option to access these areas via modes other than driving.

ANALYSIS

The final recommended location and conceptual design of the Main Street undercrossing was considered from a number of alternatives screened through quantitative and qualitative measures. These measures included existing pedestrian and bicycle flows, connectivity to the broader sidewalk and trail system, connections to destinations, the feasibility of construction, and estimated cost. A total of six grade-separated crossings were considered including one undercrossing and one overpass east of the BNSF railroad tracks, and three undercrossings and one overpass west of the railroad tracks. Both undercrossing and overpass

alternatives were considered to illustrate space requirements, massing constraints, and potential design and cost comparison between each option.

The final recommended design west of the BNSF railroad tracks, and adjacent to the intersection, was chosen by the City Council in October 2018. The proposed undercrossing most aligns with existing flows of people walking and bicycling, especially vulnerable users such as school children, who primarily access Main Street from the northeast. The undercrossing also provides direct connections between destinations along South Boulder Road, as well as the middle school and downtown to the south. Moreover, it represents a feasible design that least impacts private property.

DESIGN

The recommended design would provide both ramp and stairwell access to an approximately 100 foot long tunnel under South Boulder Road. The total travel distance, including the access ramps and tunnel, would be approximately 400 feet. A conceptual illustration of grading and a cross section of utilities can be found in the Appendix. Approximately 1,500 square feet of private property is required for the northern entrance, while an estimated 15,800 square feet is needed for the proposed southern access and connections. Figure 2 illustrates an aerial rendering of the proposed undercrossing design and ramp placement. Figure 3 and Figure 4 provide 3-D perspectives of the undercrossing looking west.

The north side access would require shifting the existing right-in, right-out driveway to the commercial businesses and parking to provide space for a stairwell that would enhance accessibility from Centennial Drive and points west. The ramp would descend between retaining walls, beginning approximately where the north side curb ramp exists today. A six-foot, curb-attached sidewalk would be maintained along South Boulder Road. Figure 5 provides an aerial perspective of the northern access point, and Figure 6 shows a rendering of the proposed design for the north side access.

The south side access includes a stairwell approximately 80 feet from the southwest corner of the intersection, as well as ramp access at a 45-degree angle. The ramp would include terraced landscaping to provide an open and comfortable environment as it descends into the tunnel. Additionally, an 8-foot sidewalk is proposed to provide ADA-accessible access where a desire line currently exists for those coming from the northwest and crossing at Centennial Drive to access Main Street. Figure 7 illustrates the southern access point from an aerial view, and Figure 8 illustrates a rendered example of the design for the southern entrance.

It is recommended that connections to the Main Street undercrossing be considered in future design efforts and project implementation. Other improvements include shared-use sidewalks (8-10 feet wide) connecting the undercrossing to the existing off-street trails north of the intersection via the west side of Steel Street and east side of Centennial Drive. Additionally, a shared-use sidewalk is recommended along the west side of Main Street between the south entrance to the undercrossing and Louisville Middle School. Low-stress bike lanes (potentially buffered per the existing street width) on Main Street could also provide a connection for bicyclists between the undercrossing and downtown Louisville.

COST & IMPLEMENTATION

The estimated cost of the undercrossing and all associated improvements is approximately $8.7 million. This includes the cost of right-of-way acquisition, utility and traffic signal relocation, retaining walls, lighting and landscaping, and character enhancements such as colored concrete. Table 1 illustrates the cost breakdown in 2019 dollars. Costs may fluctuate in the interim as additional design is completed before construction. A detailed cost estimate can be found in the Appendix.

The signal improvement costs estimated for the project only include replacement of those impacted by construction of the north side ramp and access. The City may want to consider replacing all signal infrastructure at the Main Street intersection as a part of this project, however, those additional costs are not included in the overall estimated project cost.

In the future, the City may want to purchase the Animalhouse Veterinary Clinic property should the owner be willing to sell, in an effort to potentially reduce costs associated with shoring and retaining walls due to the constrained right-of-way. There are potential minor construction savings; however, final purchase price for the entire property could offset those savings. Additional design is required to quantify the exact cost and estimated savings. As of March 2019, the owner of the vacant parcel on the south side of South Boulder Road has stated that their condition to the City is purchasing the entire parcel for the project instead of the portion needed for construction. Cost estimates for right-of-way acquisition only include the area needed for ramp approaches and the shared use path, not the entire property.

The estimated implementation schedule assuming funding is secured includes 12 to 18 months for design and bidding, and one year for construction.

TABLE 1: MAIN STREET UNDERCROSSING COST ESTIMATE					
SIGNAL IMPROVEMENTS	SITE DEMOLITION	UTILITIES	RIGHT-OF-WAY	SITE WORK	LANDSCAPE & IRRIGATION
$160,000	$315,000	$405,000	$471,000	$2,990,000	$78,000
				SUBTOTAL	$4,419,000
				ADDITIONAL PROJECT COSTS AND CONTINGENCIES[1]	*$4,320,000*
				TOTAL ESTIMATED PROJECT COST	**$8,739,000**

Source: Fehr & Peers, Russell + Mills Studio, March 2019

[1] Includes survey, design, construction management, mobilization, traffic control, environmental/water quality contingencies as well as a 20 percent overall project contingency.


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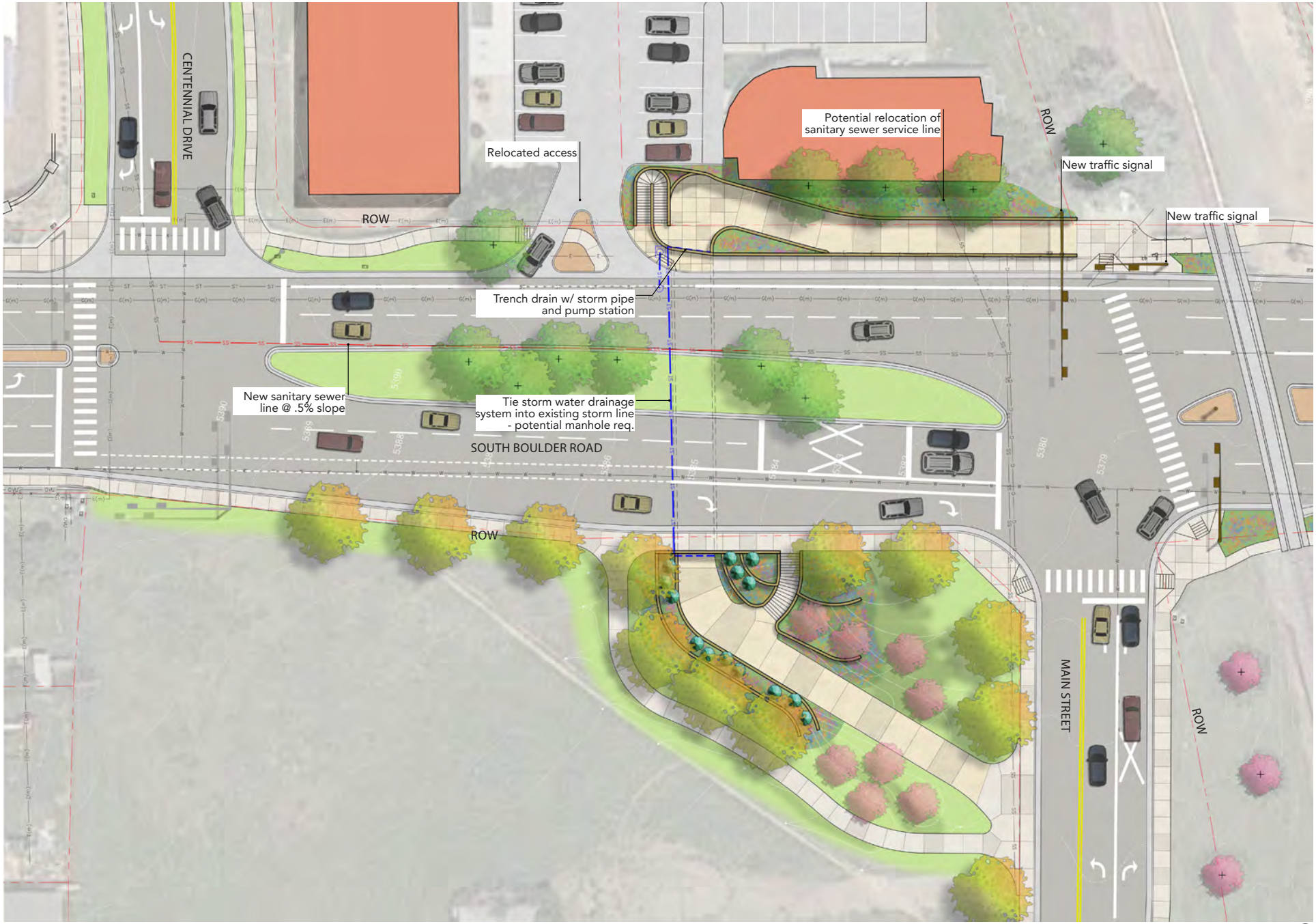

Figure 2: Main Street Undercrossing Plan Rendering

FIGURE 3: 3D AERIAL VIEW OF MAIN STREET UNDERCROSSING LOOKING WEST

FIGURE 4: 3D AERIAL VIEW OF MAIN STREET UNDERCROSSING LOOKING NORTHWEST

FIGURE 5: AERIAL PERSPECTIVE OF NORTHERN ACCESS POINT

FIGURE 6: NORTH SIDE ENTRANCE AND TRAIL

FIGURE 6: NORTH SIDE ENTRANCE AND TRAIL

FIGURE 7: AERIAL PERSPECTIVE OF SOUTHERN ACCESS POINT

FIGURE 8: SOUTH SIDE ENTRANCE AND TRAIL

FIGURE 8: SOUTH SIDE ENTRANCE AND TRAIL

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At-Grade Crossing Improvements

At-grade crossing improvements are proposed at five intersections along South Boulder Road. The objective of the recommended improvements is to provide safety and mobility enhancements that can be implemented in the short-term to benefit all users of South Boulder Road. Safety highlights for people walking or bicycling include reduced crossings distances, minimized conflicts with turning vehicles through signal modifications, and a Pedestrian Hybrid Beacon at Eisenhower Drive. The proposed improvements would also benefit people driving on the corridor through countermeasures to identified safety issues per the crash history and traffic operations analyzed as a part of this planning effort. Proposed countermeasures for these areas of concern include protected left-turn movements, the extension of left-turn storage lanes, and a right-turn on red restriction at Via Appia.

Photo examples of the proposed at-grade infrastructure improvements can be found on page 25 and 26.


S Boulder
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ENHANCED CROSSING SIGNAGE

PEDESTRIAN HYBRID BEACON

PEDESTRIAN ISLAND REFUGE WITH CROSSWALK THROUGH MEDIAN

SHARED-USE SIDEWALK

CURB EXTENSION

CROSSWALK WITH ADVANCED STOP BAR

LEADING PEDESTRIAN INTERVAL (LPI)

NO RIGHT-TURN LED BLANK OUT SIGN

Main Street

Figure 10 illustrates the conceptual design of recommended improvements.

SIGNAL IMPROVEMENTS

• **Protected-only left-turn:** Convert the westbound left-turn signal head from protected-permissive to protected-only.

• **Signal timing:** Due to the proposed reduction in crossing distance, re-optimize splits to account for decrease in needed walk time. Maintain six second leading pedestrian interval (LPI).

INFRASTRUCTURE IMPROVEMENTS

• **Curb Extension:** Extend the southeast corner of the intersection and add directional curb ramps.

• **Crosswalk:** Realign the east crosswalk to new curb ramp, and refresh all crosswalk markings and stop bars.

• **Left-turn Lane:** Extend the westbound left-turn storage lane approximately 170 feet to accommodate potential queueing from signal changes.

ADDITIONAL CONSIDERATIONS

The proposed extension of the westbound left-turn storage lane would require the removal of the existing eastbound left-turn storage lane that accesses the driveway immediately east of Steel Street. The north side driveway would then operationally become right-in, right-out only. The westbound left-turn storage lane into the parking lot serving 1032 South Boulder Road (Louisville Cyclery, etc.) would be maintained with a three-quarter, channelized turn design that maintains left-turn movement but restricts outbound traffic to right-out. An example of how such a design operates is shown in Figure 9.

Access restrictions could impact residents and businesses that use those driveways. It is recommended that the City further study the potential effects and trade-offs of restricting access and work with property owners to identify potential outcomes that provide reasonable access to those properties. The existing traffic volumes at the intersection exceed a threshold for permissive left-turn operations illustrating the limited availability of gaps in traffic and potential for crashes to occur.[2] During field visits near-misses were observed which included conflicts between turning vehicles and eastbound through vehicles, or those crossing Main Street by walking or bicycling.

Main Street and Centennial Drive currently operate as a clustered signalized intersection. Further study regarding the potential pros/cons of clustered versus coordinated operations at this intersection are suggested to ensure that the intersections are operating at peak efficiency for all users of South Boulder Road. This could potentially be tested when two of the three signals at Main Street are reconstructed in tandem with the implementation of the Main Street undercrossing.

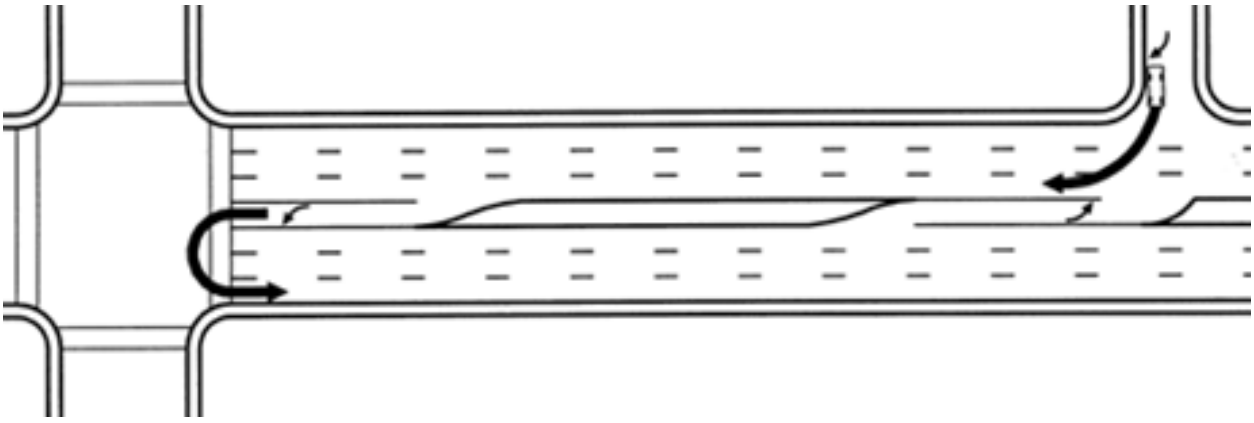

Figure 9: Example of channelized left-turn with right-in, right-out only restriction

[2] NCHRP, Reprot 812, *Signal Timing Manual, Second Edition* (FHWA, 2015).

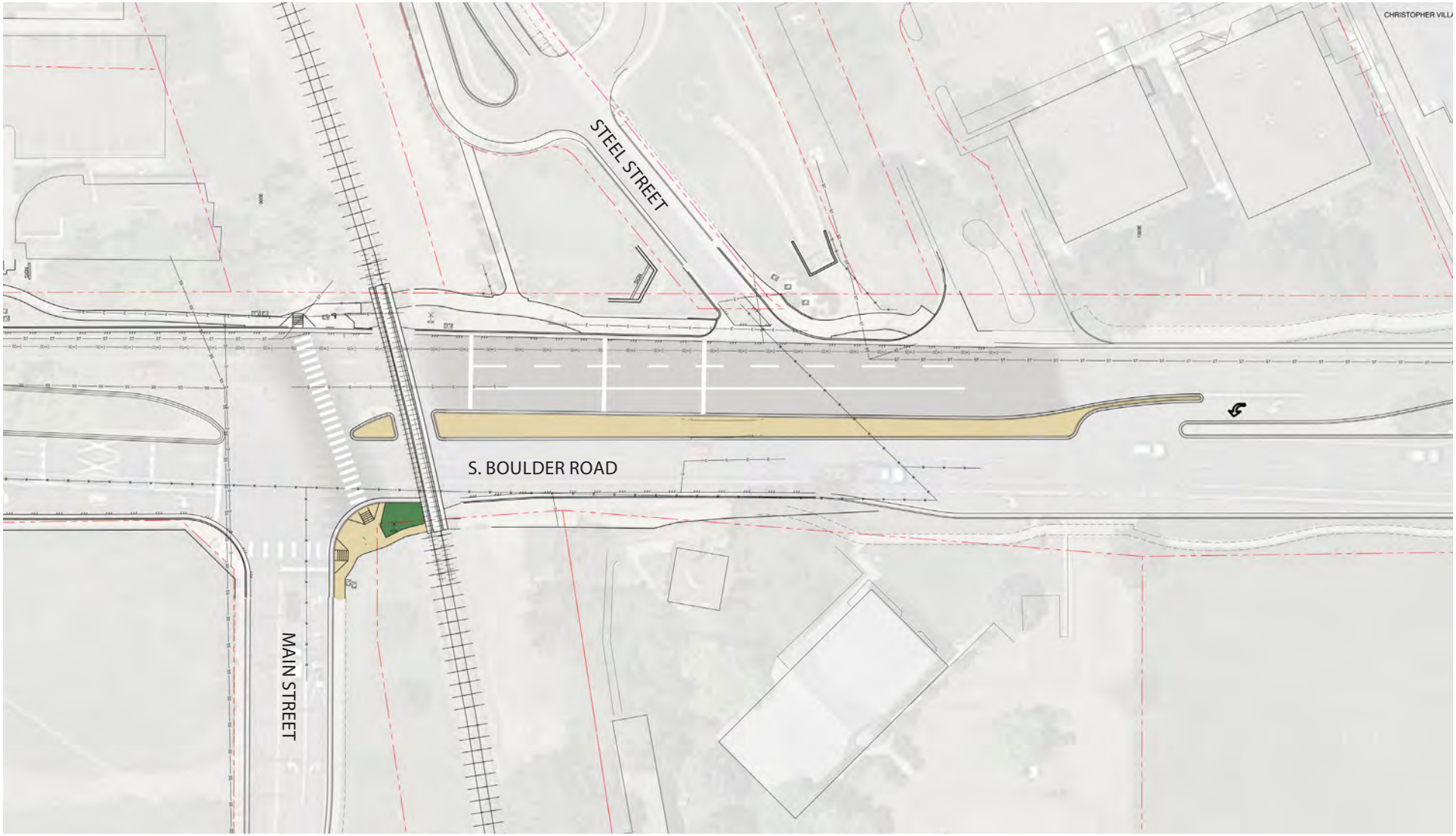

Figure 10: Main Street At-Grade Improvements


S. Boulder

Centennial Drive

Figure 11 shows the conceptual design of recommended improvements.

SIGNAL IMPROVEMENTS

• **No Right-turn when Pedestrians Present:** Install a No Right-Turn LED blank out sign for southbound vehicles.

• **Leading Pedestrian Interval (LPI):** Add a six second LPI for north-south crossing.

INFRASTRUCTURE IMPROVEMENTS

• **Median Extension:** Extend the west side median and include cut-through ramp for crosswalk.

• **Crosswalk:** Refresh all crosswalk markings and stop bars.

• **Left-turn Lane:** Extend the eastbound left-turn storage lane approximately 80 feet to accommodate potential queueing.

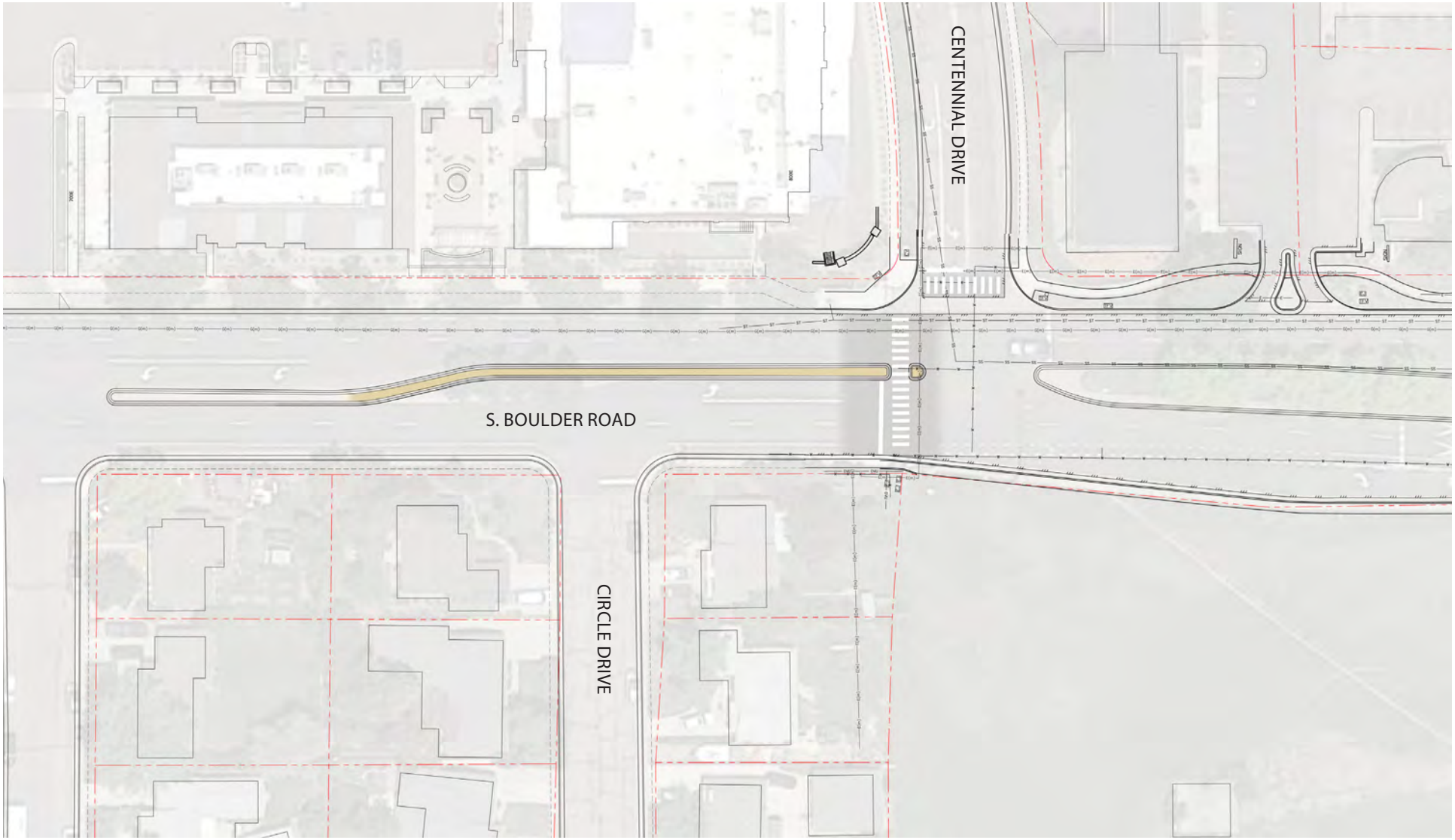

Figure 11: Centennial Drive At-Grade Improvements

Garfield Avenue

Figure 12 shows the conceptual design of recommended improvements.

SIGNAL IMPROVEMENTS

• **Protected-permissive left-turn:** Convert the westbound and eastbound left-turn signal heads from permissive to protected permissive.

• **Signal Pole/Mast:** Install new eastbound signal to accommodate recommended signal head.

• **Signal Timing:** Update the intersection's signal timing plan to include protected left-turn movements and re-optimize.

• **Leading Pedestrian Interval (LPI):** Add a six second LPI for both South Boulder Road crossings and appropriate signage.

INFRASTRUCTURE IMPROVEMENTS

• **Curb Extension:** Extend the southeast corner of the intersection and add directional curb ramps.

• **Median Extension:** Extend both medians and include cut-through ramps for crosswalks.

• **Crosswalk:** Refresh all crosswalk markings and stop bars.

ADDITIONAL CONSIDERATIONS

Conceptual review of the westbound signal illustrated that the pole and mast can accommodate the additional weight of the new signal head; however, the mast may not meet the needed length to properly serve the left-turn lane. Additional field verification and analysis is recommended to ensure the existing mast length can properly accommodate the signal head.

Additionally, it is recommended that eastbound and westbound left-turn storage lane queuing be monitored to ensure spillback into the through travel lanes does not occur due to the left-turn signal operation changes.

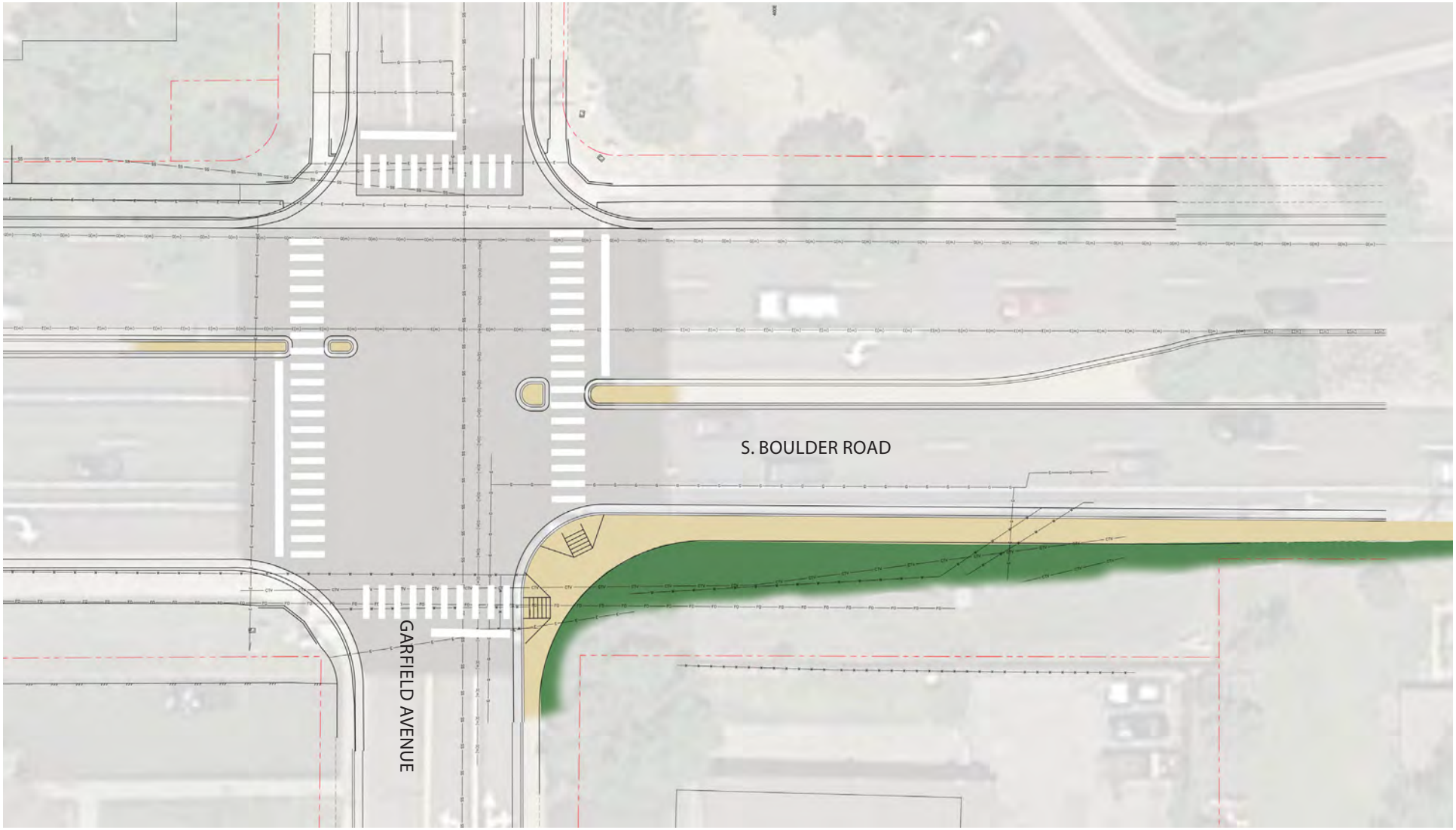

Figure 12: Garfield Avenue At-Grade Improvements

Via Appia

Figure 13 and 14 show the conceptual design of recommended improvements.

SIGNAL IMPROVEMENTS

• **Protected-only left-turn:** Convert the westbound left-turn signal head from protected-permissive to protected-only.

• **Signal Timing:** Re-optimize the intersections splits and maintain a six second LPI.

• **No Right-turn on Red:** Add signage for no right-turn on red (RTOR) at all times for the northbound right-turn.

INFRASTRUCTURE IMPROVEMENTS

• **Curb Extension:** Extend the southeast corner of the intersection and add directional curb ramps.

• **Median Extension:** Extend both medians and include cut-through ramps for crosswalks.

• **Crosswalk:** Realign the south crosswalk to new curb ramp, and refresh all crosswalk markings and stop bars.

• **Left-turn Lane:** Extend the westbound left-turn storage lane approximately 100 feet to accommodate potential queuing.

ADDITIONAL CONSIDERATIONS

It is recommended that the existing curb cut providing westbound left-turn access to the south driveway for Cottonwood Park be removed, and the driveway operations changed to right-in, right-out only.

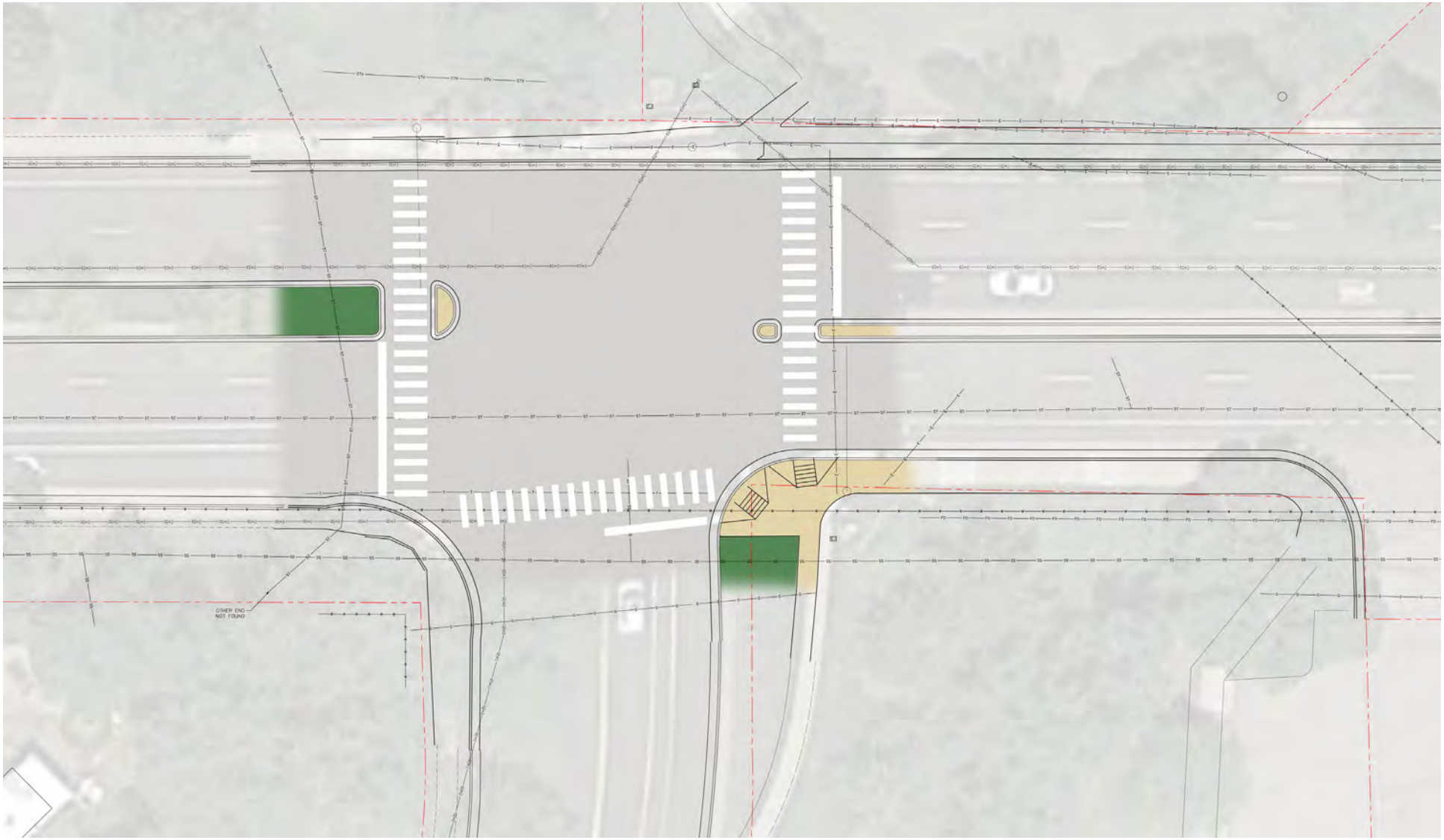

Figure 13: Via Appia At-Grade Intersection Improvements

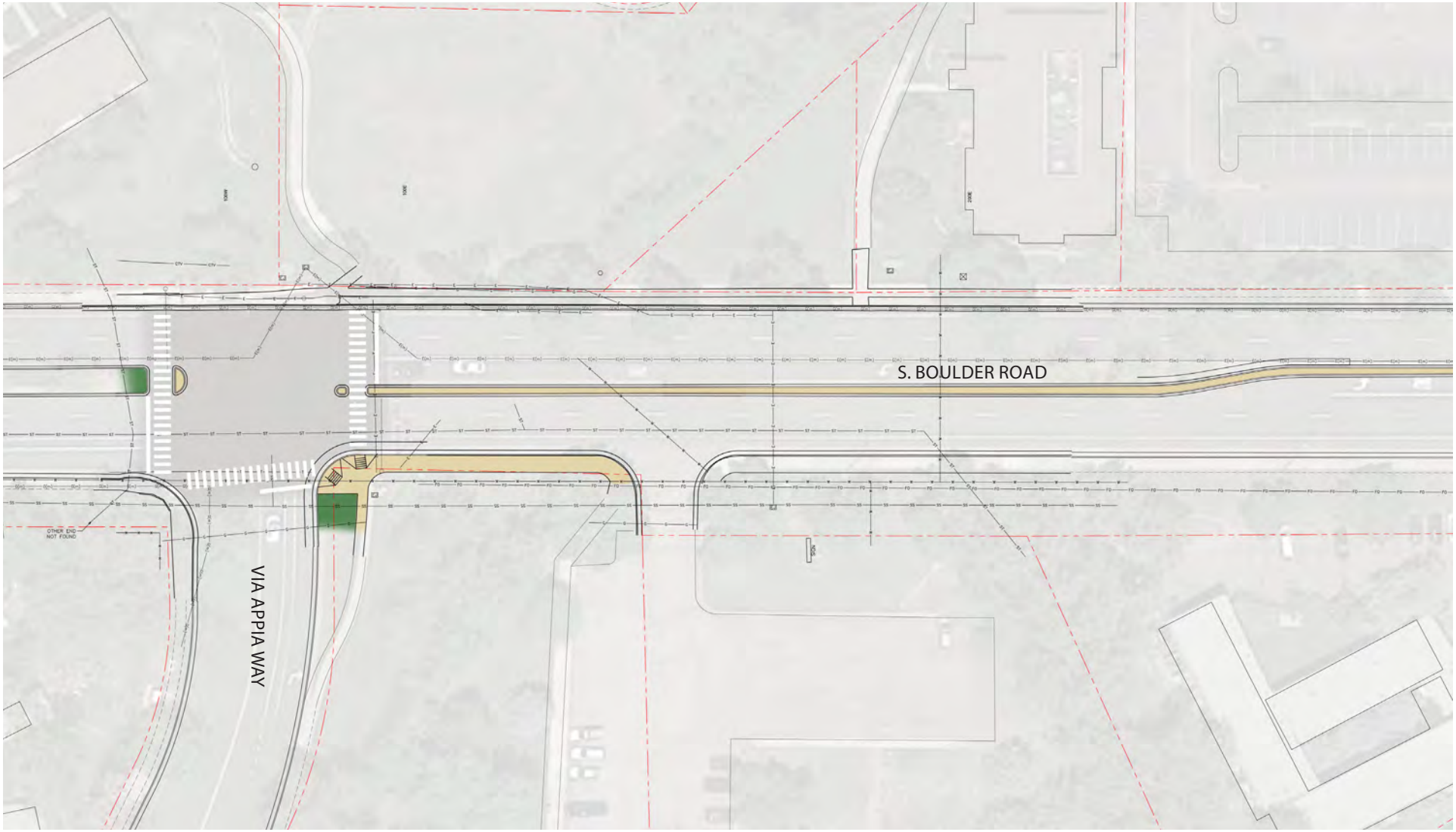

Figure 14: Via Appia Left-Turn Storage Lane Improvements

Eisenhower Drive

Figure 15 shows the conceptual design of recommended improvements.

INFRASTRUCTURE IMPROVEMENTS

- **Pedestrian Hybrid Beacon:** Install a Pedestrian Hybrid Beacon for eastbound and westbound traffic.
- **Median Extension:** Extend the east side median and include cut-through ramp for crosswalk.
- **Crosswalk:** Refresh crosswalk markings, install stop bars, and add applicable crossing signage.

ADDITIONAL CONSIDERATIONS

The *Manual on Uniform Traffic Control Devices 2009 (MUTCD)* outlines that marked crosswalks alone, without other measures designed to reduce traffic speeds, shorten crossing distances, enhance driver awareness of the crossing, and/or provide active warning of pedestrian presence, should not be installed across uncontrolled roadways where the speed limit exceeds 40 mph; the roadway has four or more travel lanes; and with a raised median a minimum 15,000 daily vehicles.[3] At the existing uncontrolled Eisenhower Drive crossing, the speed limit is at the 40 mph threshold, there are four travel lanes, and the ADT is 17,200.[4]

Pedestrian crossing guidelines developed for the City and County of Denver and the City of Boulder both would suggest a Pedestrian Hybrid Beacon at this location due to the speed, vehicle ADT, and number of travel lanes at this location.[5]

In the long-term, monitoring of crossing demand is recommended to determine if the Pedestrian Hybrid Beacon is operating acceptably before considering implementation of a grade-separated crossing.

[3] MUTCD (2009), Chapter 3B-19
[4] Boulder County Traffic Counts, 2018.
[5] Denver Uncontrolled Pedestrian Crossing Guidelines (2016); Boulder Pedestrian Crossing Treatment Installation Guidelines (2011)

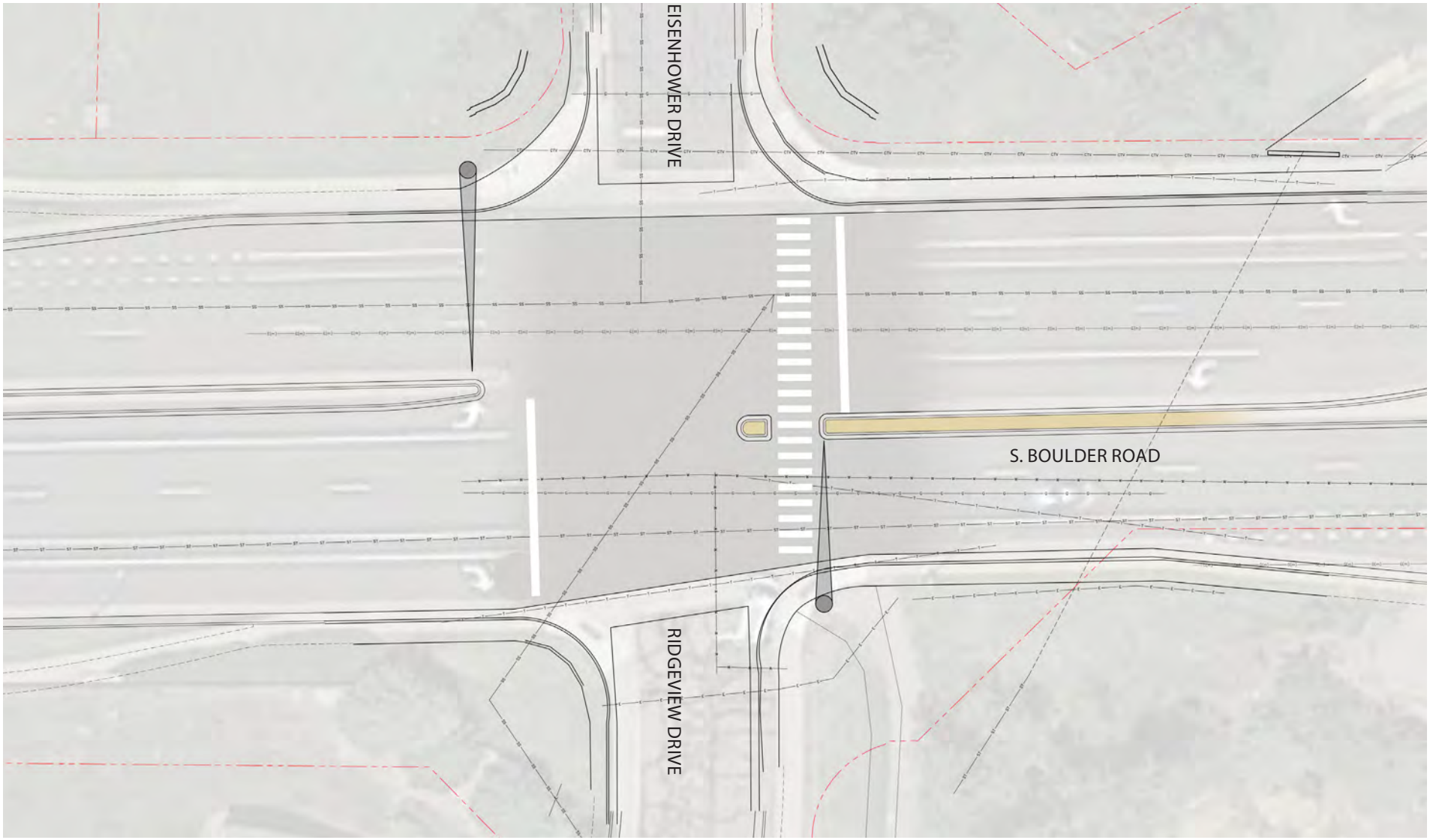

Figure 15: Eisenhower Drive At-Grade Intersection Improvements

OVERALL BENEFITS

The proposed at-grade improvements would benefit people walking and bicycling, as well as people that drive through the corridor. The signal and operational changes, and the geometric crossing improvements at each intersection would enhance the safety, comfort, and accessibility of all users along South Boulder Road.

SIGNAL AND OPERATIONAL IMPROVEMENTS

- **Protected Left-Turn:** Reduces the potential for conflict between turning vehicles and people walking, bicycling, or driving.

- **Leading Pedestrian Interval (LPI):** Provides people crossing, especially vulnerable users, the opportunity to safely enter the intersection and begin crossing before vehicles may turn. LPIs have been shown to reduce pedestrian-vehicle crashes by as much as 60 percent.[6]

- **No Right-turn LED Sign:** Provides additional warning for turning vehicles to stop and watch for people crossing.

- **No Right-turn on Red:** A restriction at all times for northbound right-turns at Via Appia addresses a crash history (seven crashes in three years) caused by that movement. The MUTCD identifies three right-turn crashes in one year as an impetus for this restriction, of which 2016 and 2018 would exceed and meet this threshold, respectively.[7]

- **Pedestrian Hybrid Beacon:** Provides people walking and bicycling the ability to stop traffic and safely cross South Boulder Road at Eisenhower Drive, which is approximately 100 feet wide at this location and has a posted speed limit of 40 mph.

INFRASTRUCTURE IMPROVEMENTS

- **Curb Extension:** Shortens the crossing distance by approximately 20 feet at each location and slows the speed of right-turning vehicles due to the tightened curb radii.

- **Pedestrian Island Refuge:** Extending the medians across the existing crosswalks provides people crossing with a more comfortable experience and slows the speed of left-turning vehicles.

[6] NACTO, 2013.
[7] MUTCD, Chapter 2B-54

- **Crosswalk Markings and Stop Bars:** Provide clear delineation of the pedestrian zone, and defines the space to maintain a safe distance and level of comfort between people crossing and waiting vehicles.

- **Left-turn Storage Lane Extensions:** The recommended signal operation changes may require extending the left-turn storage lanes at Main Street, Centennial Drive, and Via Appia to ensure that vehicle queueing does not extend into the through travel lanes during peak hours.

Of note, the turning movements of a fire truck were studied at all intersections, as well as a 40-foot RTD bus and semi-truck (WB-50) at applicable intersections. These tests were conducted to ensure that curb and median extensions would not hinder the turning of these vehicle types.

All vehicles successfully completed right- and left-turns with the proposed infrastructure.

TRAFFIC ANALYSIS

Detailed analysis of the operational effects to vehicular traffic on South Boulder Road was completed to identify potential impacts of the proposed at-grade improvements. Using SimTraffic, the one-mile corridor was simulated with existing traffic counts to study the effects signal modifications, a right-turn on red restriction, and the addition of a Pedestrian Hybrid Beacon at Eisenhower Drive would have on the Level of Service (LOS) and queueing at each intersection. Total vehicular travel time between Eisenhower Drive and Main Street was also studied to identify potential impacts for people driving.

LEVEL OF SERVICE

Level of Service (LOS) is a common grading system put forth by the Transportation Research Board's *Highway Capacity Manual*. LOS characterizes the operation conditions of an intersection's traffic flows, ranging from an LOS A which indicates traffic conditions with little or no delay, to LOS F which represents traffic conditions that result in long queues and significant delays. The system of grades represents driver perspectives and indicate the comfort and convenience associated with driving. The City of Louisville does not have a minimum threshold policy for LOS, however, many jurisdictions consider acceptable a LOS of D or better.

Table 2 illustrates the existing LOS per intersection in the morning and afternoon peak hours and the potential LOS after all recommended at-grade improvements are implemented. The column to the far-right shows the change in seconds of delay between the two scenarios. Increases in delay can be attributed to the implementation of protected left-turns which reduce the amount of green time allocated to the eastbound and westbound through movements.

TABLE 2: LEVEL OF SERVICE (LOS) WITH AT-GRADE IMPROVEMENTS

STUDY INTERSECTION	PEAK HOUR	EXISTING CONDITIONS		EXISTING + AT-GRADE CONDITIONS		Δ DELAY (SEC)[2]
		LOS	DELAY[1]	LOS	DELAY	
Main Street / South Boulder Road	AM	B	15	C	24	+9
	PM	B	18	C	21	+3
Centennial Drive / South Boulder Road	AM	B	13	B	19	+6
	PM	C	29	D	47	+18
Garfield Avenue / South Boulder Road	AM	B	11	B	15	+4
	PM	B	13	B	17	+4
Via Appia / South Boulder Road	AM	A	8	C	20	+12
	PM	C	21	C	32	+11

Source: Fehr & Peers, January 2019

[1] Delay measured in seconds for the overall intersection.

[2] Change in delay between existing and proposed conditions.

TRAVEL TIME

Table 3 shows the existing travel time (in seconds) along South Boulder Road between Eisenhower Drive and Main Street, and the potential travel time after at-grade improvements are implemented. The change in travel time to eastbound and westbound traffic during the AM and PM peak hours illustrates the potential effect on traffic flows between the existing and proposed conditions.

TABLE 3: PEAK HOUR TRAVEL TIME WITH AT-GRADE CROSSING IMPROVEMENTS

DIRECTION	PEAK HOUR	EXISITING[1]	E + IMP.	Δ IN TIME
Eastbound South Boulder Road Corridor[2]	AM	139	154	+15
	PM	185	194	+9
Westbound South Boulder Road Corridor	AM	101	118	+17
	PM	99	108	+9

Source: Fehr & Peers, January 2019

[1] Travel time measured in seconds.

[2] Extent of corridor measured is from immediately west of Eisenhower Drive to Main Street.

The marginal increase in travel times is due to the implementation of protected-only left-turns at Main Street and Via Appia, and protected-permissive left-turns (which means left-turning vehicles receive both a green arrow, as well as a green ball where drivers must yield to oncoming through vehicles) at Garfield Avenue. The operational changes as recommended reduce the green time allocated to eastbound and westbound through movements on South Boulder Road.

It is recommended during the AM peak hour that signal coordination be focused on the eastbound direction to maximize bandwidth and reduce travel time for vehicles in that direction due to the recommended left-turn protection. Currently, both eastbound and westbound directions are coordinated which does not optimize travel time or reduce potential delay in the eastbound direction from the recommended changes to signal operations.

COST & IMPLEMENTATION

The proposed at-grade signal and infrastructure improvements are estimated to cost approximately $1.3 million including contingencies (in 2019 dollars) as illustrated in Table 4. The estimated project costs could change as the design is further refined, and should be considered conceptual. A detailed breakdown of estimated costs per intersection is included in the Appendix.

TABLE 4: SOUTH BOULDER ROAD AT-GRADE IMPROVEMENTS COST ESTIMATE

INTERSECTION	SIGNAL IMPROVEMENTS	INFRASTRUCTURE IMPROVEMENTS	TOTAL ESTIMATED COST
Main Street	$1,000	$111,000	$112,000
Centennial Drive	$4,000	$72,000	$76,000
Garfield Avenue	$47,000	$97,000	$144,000
Via Appia	$20,000	$101,000	$121,000
Eisenhower Drive	$157,000	$26,000	$183,000
SUBTOTAL	$229,000	$407,000	$636,000
Additional Project Costs and Contingencies[1]			*$715,000*
TOTAL COST FOR AT-GRADE CROSSING IMPROVEMENTS			**$1,351,000**

Source: Fehr & Peers, Russell + Mills Studio, January 2019

[1] Includes survey, design, construction management, mobilization, traffic control, environmental/water quality, and overall project contingency costs.

The at-grade designs are conceptual and should not be considered construction-level documents. Quantity take-offs are estimated from the concept designs which did not include survey. A 25 percent contingency on the total project cost was applied, as well as soft costs for survey, design, construction, and other project controls (environmental, water quality, etc.).

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Other Potential Undercrossings

Two other grade-separated undercrossings were considered per direction by the community in previous planning efforts, as well as input from the City Council. The two locations include Via Appia and Eisenhower Drive where trail crossings exist. The two undercrossings are considered long-term improvements and are dependent upon the installation of priorities both identified in this plan as well as other city-wide efforts such as the Transportation Master Plan.

Both undercrossings were only designed to conceptual detail, and therefore, all cost estimates and constraints were identified to that level in 2019 dollars. Cost estimates will fluctuate as additional analysis and design are completed.


YIELD

Via Appia

BACKGROUND

A grade-separated crossing serving the existing off-street trail was identified in the *South Boulder Road Small Area Plan (2016).* The existing trail connects the north and south parts of Louisville with parks and open space, residential neighborhoods, and other destinations.

ANALYSIS

A review of the peak weekday pedestrian and bicyclist demand at Via Appia was conducted, with relatively low usage observed. It was determined that due to nearby destinations such as Cottonwood Park and other open space, the nearby trails and crossing likely experience higher usage during off-peak times or on weekends. During the AM and PM peak hours there are approximately 220 to 390 northbound right-turning vehicles respectively, which contributes to an uncomfortable crossing environment for people walking and bicycling. Future trail planning was also considered when recommending the undercrossing as the existing off-street trail is planned to be upgraded and extended in the future as a regional trail link connecting far northeast and southwest Louisville and trails external to the City.

Only one design was considered at Via Appia due to the constraints posed by the existing private property to the north, ditch easement both north and south of South Boulder Road, and the desire to align the crossing and ramps entirely within city-owned property. Grade-separation is recommended at Via Appia east of the ditch easement following other priority grade-separation projects identified both in this plan and through other city-wide planning efforts, as well as upon completion of future identified trail upgrades and connections.

DESIGN

A conceptual design was completed for a grade-separated crossing as seen in Figure 16. Additional analysis is required for easement and utility locations, study of elevation and topography, and desired vehicular access to Cottonwood Park, as well as additional designs completed before construction.

The proposed concept includes an approximately 100-foot tunnel under South Boulder Road, and 12-foot wide access ramps connecting to the existing trail system. The character and feel of the undercrossing would emulate the existing undercrossing near Washington Avenue. Though the crossing would likely be used primarily by bicyclists via the trail, vertical access provided by ramps or stairs from the sidewalks along South Boulder Road is recommended to benefit those walking along the corridor.

COST & IMPLEMENTATION

The conceptual estimated cost of the undercrossing and all associated improvements is between $5.5 million and $6 million. Due to the level of design, the estimated cost will likely change as additional design work and detailed estimates are completed.

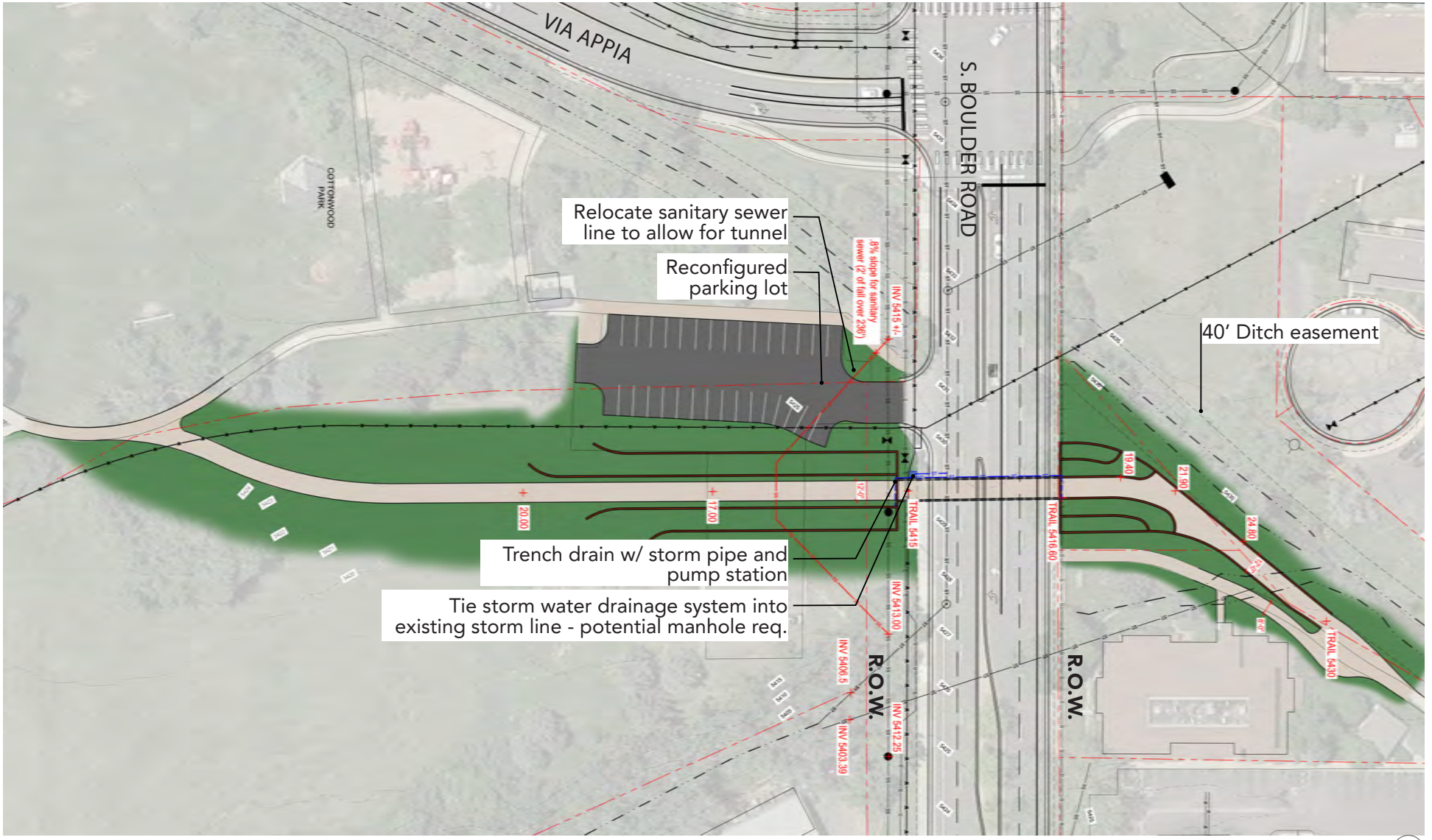

Figure 16: Via Appia Undercrossing Conceptual Design

Eisenhower Drive

BACKGROUND

The study of a grade-separated crossing serving the existing off-street trail was identified by the City Council. A marked, uncontrolled crossing currently exists for people crossing at this location; however, this treatments does not meet MUTCD guidelines or guidelines produced by Denver or Boulder to address crossing treatments.

ANALYSIS

A review of the peak weekday pedestrian and bicyclist demand at this crossing was conducted with relatively low usage observed. A trail exists at this location which is paved to the north and unpaved to the south of South Boulder Road. The trail at this location is designated as a local trail versus a regional trail connection which hierarchically is connectively more important and likely experiences greater demand. There are no long-term upgrades for this trail as opposed to the trail near Via Appia.

It is recommended that a Pedestrian Hybrid Beacon is installed at this location to address potential safety and comfort issues due to the existing uncontrolled crossing. This crossing enhancement will serve as a feasible and affordable short-term upgrade to improve the safety for those crossing at this location where traffic volumes and speeds are higher. Grade-separation is recommended following other priority grade-separation projects identified both in this plan and in other city-wide planning efforts, such as the Transportation Master Plan.

DESIGN

A conceptual design was completed for the grade-separating crossing as shown in Figure 17. Additional analysis of the ditch easement and utility locations, private property constraints, and the elevation and topography are required. The design is made difficult due to the ditch easement and private property boundaries.

The proposed conceptual design includes an approximately 140-foot tunnel under South Boulder Road, and 12-foot wide access ramps connecting to the existing trail system. Additional retaining walls would likely be required due to the ditch and property constraints.

COST & IMPLEMENTATION

The conceptual estimated cost of the undercrossing and all associated improvements is between $5 and $5.5 million. Due to the level of design, the estimated cost will likely change as additional design work is completed.

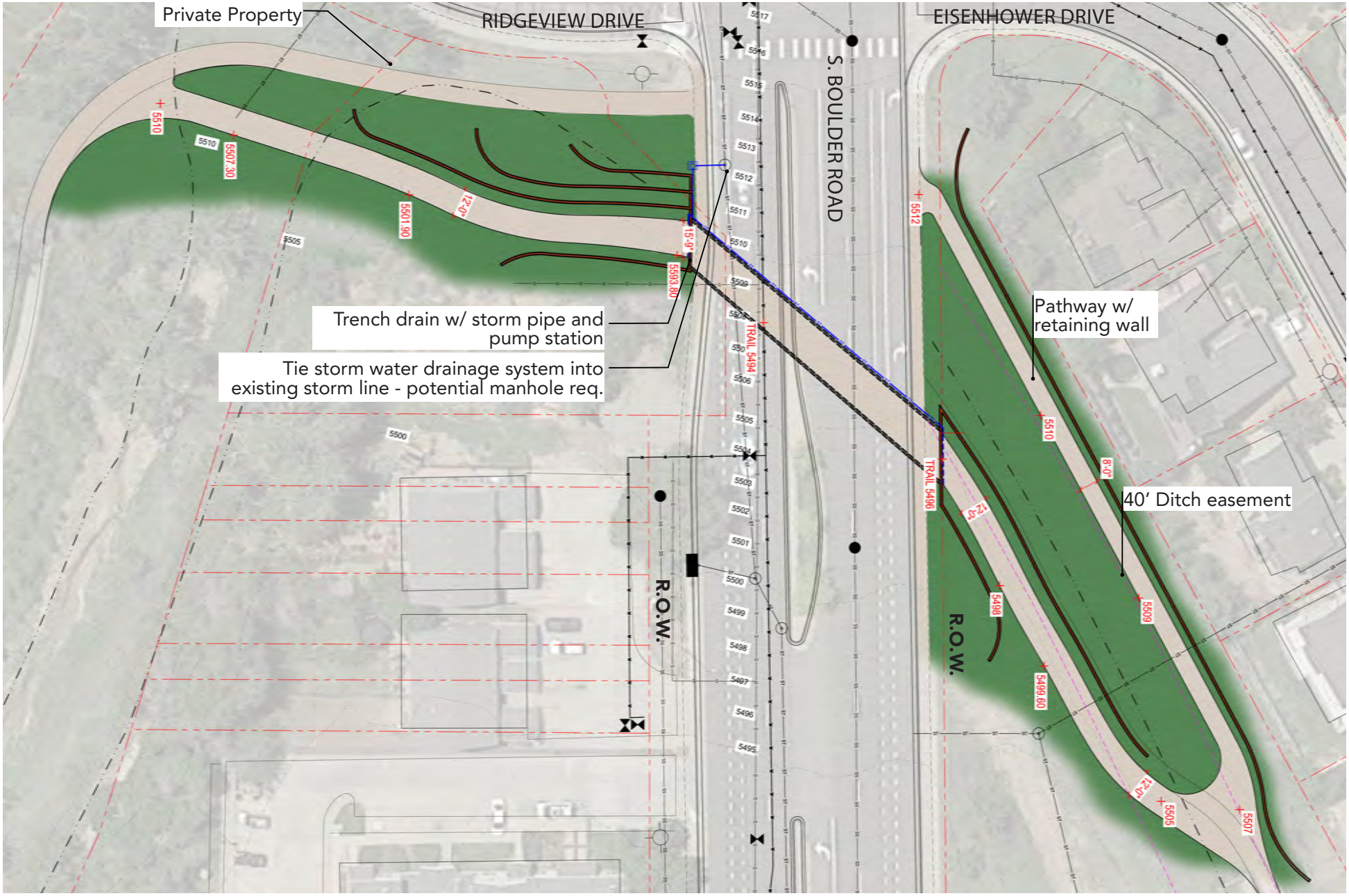

Figure 17: Eisenhower Drive Undercrossing Conceptual Design

Transportation Funding Sources

Potential funding sources from Federal, State, DRCOG, and other Colorado-specific entities for transportation projects in the City of Louisville were studied.

FEDERAL FUNDING

Most transportation funding is distributed at the Federal level formulaically to State Departments of Transportation (DOTs) or Metropolitan Planning Organizations (MPOs). Remaining competitive discretionary grant opportunities exist via the Federal Transit Administration (FTA) and Federal Highway Administration (FHWA). At the Federal-level grants for Louisville either are not attainable due to certain requirements such as the amount of project funding required (many examples illustrate projects in the tens or hundreds of millions) or required jurisdictional population (typically reserved for a principal metropolitan city or those that are 50,000+).

BUILD Transportation Discretionary Grant funding, which replaced TIGER in 2018, is provided by the U.S. Department of Transportation for any level of government or agency to apply for funding either individually or as a joint application. Eligible capital projects include road or bridge projects, public transit, or intermodal projects that will provide a significant local or regional impact. Approximately $1.5 billion was made available in 2018, with a minimum project award of $5 million (maximum of $25 million), or a total of $6.5 million with the required 30 percent match. The most recent application deadline was in July 2018. Of note, grant funding recipients were concentrated in rural locations versus those in urban areas due to objectives pursued by the current administration.

It is recommended that Louisville only pursue BUILD grant funding if multi-million dollar transportation projects arise that possess significant impacts. Otherwise, the grant application and administrative requirements are far too great if less than 50 percent of total project costs would potentially be funded. Moreover, the funding is incredibly competitive with over $10.9 billion of projects requested nationwide.

STATE FUNDING

CDOT provides transportation grant funding at the state-level through four primary areas applicable for municipalities with safety and/or multimodal project objectives.

• **FASTER - Safety:** Eligible projects include those that reduce crashes, enhances highway features or functions, improve pedestrian and bicycle safety, or leverage funding opportunities with an existing project. A total of $80 million is allocated annually of which 18 percent is provided to municipalities.

• **Transportation Alternatives Program (TAP):** Eligible projects include pedestrian and bicycle facilities, projects improving non-driver access to transit, community improvement activities, and environmental mitigation. A 20 percent match is required, with a minimum project of $50,000 required. TAP grant funding for FY2018-FY2020 has already occurred, and CDOT has not publically shared when the next call for projects will ensue.

• **Highway Safety Improvement Program (HSIP):** The objective of HSIP funding is to reduce the number of crashes in areas identified as requiring infrastructure to improve safety through a quantitative approach. Approximately $4.5 to $6 million is available annually for projects in CDOT Region 4. A project (or group of projects) must equal a minimum of $50,000.

• **Safe Routes to School:** Funding is provided to both infrastructure projects within two miles of a school, as well as non-infrastructure programmatic and education elements. Approximately $1 million of non-infrastructure funding and $4 million of infrastructure funding are available statewide every two years. The minimum non-infrastructure project amount is $5,000 and the project limits for an infrastructure grant is $100,000 to $500,000 with a 20 percent match. Grant funding for FY2019-FY2020 has already occurred, with the next round of submissions in fall 2020.

CDOT funding is a potential source for local transportation projects near schools, including at-grade crossing improvements; however, that is dependent upon the upcoming grant cycle and project timing. Safe Routes to School (SRTS) grants are not recommended for larger projects, such as grade-separation, because 50 percent of construction costs would not be covered solely by that maximum allowable amount under the grant. Otherwise, the other three areas could be potential sources for transportation funding when those cycles resume.

DRCOG FUNDING

DRCOG provides funding for transportation projects in a four-year period through the Transportation Improvement Program (TIP). The intent of the TIP is to fund objectives identified in Metro Vision which include improving mobility infrastructure and services for vulnerable populations; increasing reliability of the existing multimodal network; and improving transportation safety and security.

The process was recently updated to provide a "dual mode" opportunity by funding both local priority projects in addition to regional priority projects. The process of identifying projects for regional priorities occurs prior to soliciting for local, or sub-regional, funding requests. The current cycle for FY 2020-2023 began in July 2018 and will be finalized in August 2019. Approximately $17 million was set aside for capital projects in the Boulder County sub-region, and a 20 percent match is required.

It is recommended that TIP funding be considered only if at least 50 percent of the project costs are covered by that funding. The proposed at-grade improvements would align well within the sub-regional TIP funding requests as it would meet two of the three broad objectives. The grade-separated projects included in this report would likely not secure enough funding to overcome the administrative and project requirements that this funding entails.

OTHER FUNDING

Great Outdoors Colorado (GOCO) provides funding specifically for trail construction or, in special cases, land acquisition for future trail corridors. Approximately $8.5 million is available statewide annually, with a $2 million maximum request and 25 percent match requirement. Future regional trail construction in the City could align for such funding; however, the recommended projects included in this plan will not.