



PROJECT SUMMARY REPORT  
SHERIDAN & WEST 52<sup>ND</sup>  
PEDESTRIAN SAFETY  
IMPROVEMENT PROJECT

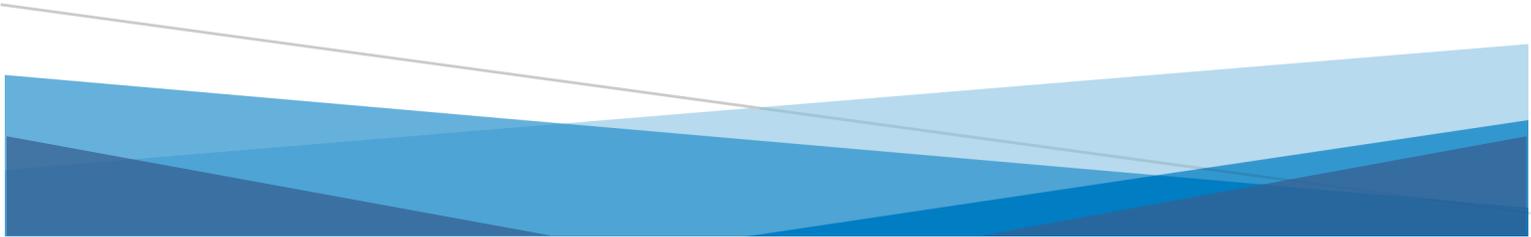
PREPARED FOR THE CITY OF DENVER

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# I. INTRODUCTION

The purpose of this Project Summary Report is to present the existing conditions and identify design considerations for the West 52<sup>nd</sup> Avenue & North Sheridan Boulevard street improvements in the vicinity of the intersection of West 52<sup>nd</sup> Avenue and North Sheridan Boulevard. This report includes those items requested by the City and County of Denver and proposed as an amendment on April 13, 2020. On September 4, 2020 SEH submitted a draft version of this report. This revised version also addresses comments received from Department of Transportation and Infrastructure (DOTI) staff pertaining to the draft report which were received by SEH on September 28, 2020.

## A. Site Location and Overall Corridor Map

The project area is located within the jurisdictions of Adams County, Jefferson County, the City of Arvada, and the City and County of Denver (CCD). The general project limits are bounded on the southern end by the intersection of West 48<sup>th</sup> Avenue and North Sheridan Boulevard, and extend north, along North Sheridan Boulevard, to the intersection of North Sheridan Boulevard and West 52<sup>nd</sup> Avenue. Along West 52<sup>nd</sup> Avenue, the project is bounded on the east by North Lowell Boulevard and on the west by North Jay Street. The general project location is shown below in Figure 1.

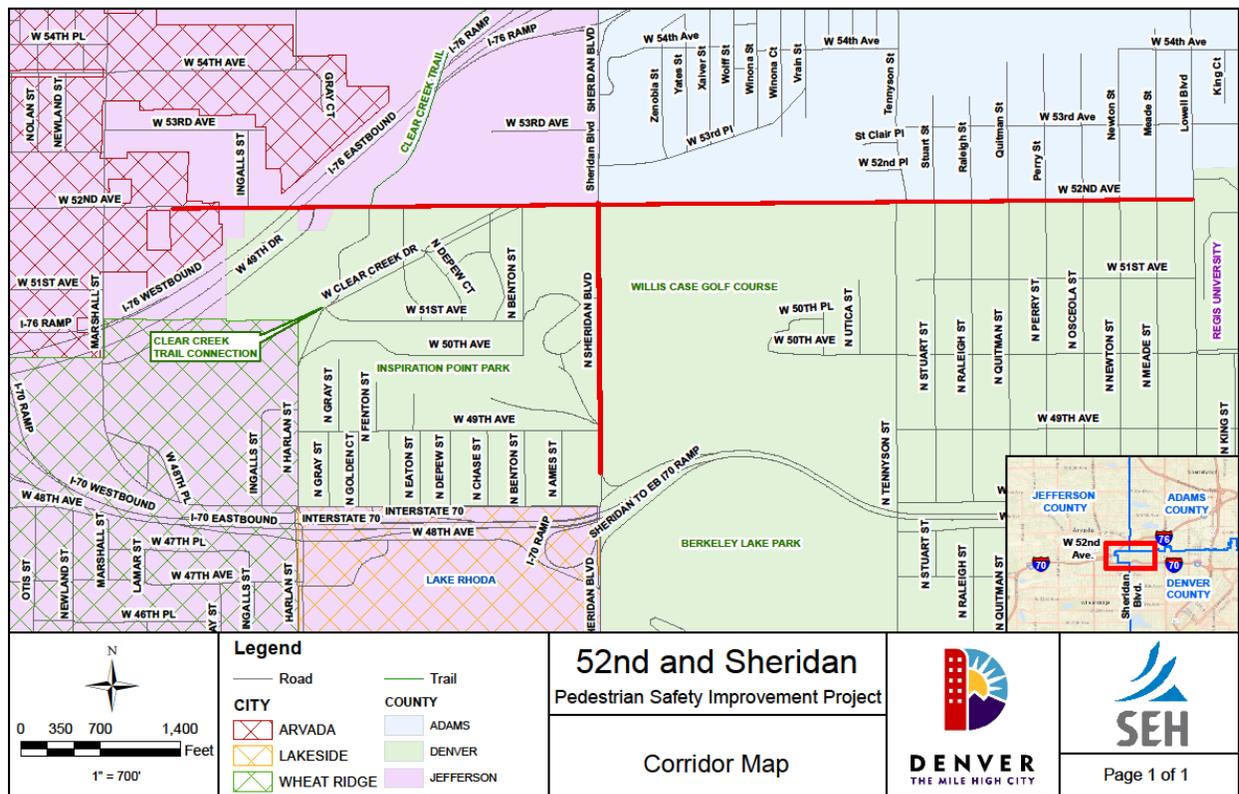


Figure 1 - Project Location Map

## B. Site Description

The Sheridan Boulevard and West 52<sup>nd</sup> Avenue Pedestrian Safety Improvement project provides preliminary design plans to enhance pedestrian and multimodal facilities along North Sheridan Boulevard and West 52<sup>nd</sup> Avenue. Existing pedestrian facilities throughout the project area consist of intermittent sidewalks and frequently used social trails. No bicycle facilities are currently provided on either street.

The consultant team developed and evaluated design concepts to provide pedestrian and multimodal improvements consistent with the City’s master planning documents. The City is interested in cost effective solutions to the numerous physical space limitations, right-of-way constraints, and construction issues presented by this project. This project develops and advances design concepts through the Concept and Preliminary submittal phases. A key project goal is completing the sidewalk systems considering current Denver Master Plans along Sheridan Boulevard from Interstate 70 to West 52<sup>nd</sup> Avenue and along West 52<sup>nd</sup>

Avenue from North Tennyson Street west to the existing sidewalks near North Jay Street. Additionally, another key project goal is to provide bicycle pathways along West 52<sup>nd</sup> Avenue, providing linkages to the Clear Creek Trail and to Regis University.

## II. EXISTING CONDITIONS

The following existing conditions inventory helps to define the project current use and characteristics to inform how the proposed improvements might impact the corridor. They include: photos, land use and zoning, curb use, sidewalk gaps, street widths, traffic signals, average daily traffic and turning movements, RTD bus stop locations and ridership, existing and planned bike routes, and vehicle crash history.

### A. Photo inventory of corridors

SEH took photos of key constraints along the corridor on July 30, 2020 which are addressed in the design of the project. These photos are labeled with constraint descriptions noted and the locations indicated on the map labeled **Appendix A**. As shown in this exhibit, constraints include:

1. A large retaining wall within the right-of-way (ROW) on the west side of North Sheridan Boulevard between Benton Way and West 50<sup>th</sup> Avenue, which limits the available space for a sidewalk;
2. Trees and large overhead power poles along the Willis Case Golf Course on the east side of North Sheridan Boulevard, which complicate the placement of a detached multi-use path or sidewalk;
3. The fence for Camp Rollandet Natural Area along the North Sheridan Boulevard right-of-way which is challenging to relocate with constraints on development within the parcel;
4. The mobile home park on the north side of West 52<sup>nd</sup> Avenue which partially encroaches into the ROW.

### B. Field observations of corridors

SEH visited the site on July 30, 2020 and reviewed roadway characteristics and land use of properties fronting the project.

#### Roadway Characteristics

- In general, West 52<sup>nd</sup> Avenue has a paved two-lane section, with left turn pockets only at North Sheridan Boulevard. Curb, gutter, sidewalk, and on-street parking are intermittent (see exhibits of Parking Inventory and Sidewalk Gaps in **Appendices C and D**, respectively). Typical lane widths are 12-13 feet, although they vary from as little as 10 feet to as much as 19.5 feet, as shown in **Appendix E**.
- In general, North Sheridan Boulevard has a paved five lane section. This includes a center lane which is variously a left turn lane or a painted center median. There is curb and gutter, but no parking. There is generally no sidewalk, except for the west side of the street from West 48<sup>th</sup> to West 49<sup>th</sup> Avenues. A social footpath trail exists on the west side of the street, from the large retaining wall south of Benton Way/West 51<sup>st</sup> Avenue and West 52<sup>nd</sup> Avenue, and along the east side of the street (see exhibits of Parking Inventory and Sidewalk Gaps in **Appendices C and D**, respectively). Lane widths vary from 9.5 feet to 11.8 feet, as shown in **Appendix E**.

For additional information and typical sections see parts III.C and R of the Project Summary Report.

#### Street Classifications

- North Sheridan Boulevard in the project area is classified as a Residential Arterial in Blueprint Denver.
- West 52<sup>nd</sup> Avenue in the project area is classified as a Residential Collector in Blueprint Denver.

### C. Land use and zoning

As outlined in the Site Location section, the project is impacted by multiple jurisdictions, each with their own land use/zoning code and descriptions. As requested by CCD, the following jurisdiction and land uses are noted:

#### Within the City and County and Denver

Within the city limits of Denver, Blueprint Denver identifies future land use designations. Existing land use found along the project corridor may differ from future designations, and are noted as well below:

- Public Park and Open Space: The Willis Case Golf Course, Inspiration Point Park, Camp Rollandet Natural Area. The existing land use matches the future land use for these properties.
- Residential Low (Density): Area south of West 52<sup>nd</sup> Avenue and also the area west of Sheridan Boulevard (other than the public park and open space areas and the areas described below). The actual land use of single unit dwellings matches the future land use designation, with the exception of the Sheridan Glen Housing on the southeast corner of North Benton Street and West 52<sup>nd</sup> Avenue. The use of this property is residential multi-unit.
- Residential Low Medium: West block face of North Sheridan Boulevard between West 48<sup>th</sup> and West 49<sup>th</sup> Avenues, except the area noted as Local Corridor below. The actual use of these properties is residential low density, as they contain single unit dwellings.
- Value Manufacturing: Area west of Clear Creek and south of West 52<sup>nd</sup> Avenue. The actual use of the property fronting on West 52<sup>nd</sup> Avenue is vacant land.
- Local Corridor: Remainder of the area west of North Sheridan Boulevard and between West 48<sup>th</sup> and West 49<sup>th</sup> Avenues. The current land use of the single property fronting North Sheridan Boulevard is commercial (retail).

#### Area outside of City and County of Denver

##### *Unincorporated Adams County*

- The area north of West 52<sup>nd</sup> Avenue between North Lowell Boulevard and North Tennyson Street is predominantly low density (single unit) residential, with some multi-unit residential as well. This area is zoned R-2 (Residential) and the comprehensive plan land use designation is Residential.
- The property at the northwest corner of North Tennyson Street and West 52<sup>nd</sup> Avenue contains a retail land use. This area is zoned C-1 (Commercial) but the comprehensive plan designation is Residential.
- West of this property the land use is low density (single unit) residential, with a large multi-unit residential complex included as well. Properties in this area are zoned a mix of R-1-C, R-2, R-4, and A-1 (Agricultural), but the entire area contains a land use designation of Residential.
- The properties at the northeast corner of North Sheridan Boulevard and West 52<sup>nd</sup> Avenue contain a retail land use and a surface parking lot. Although these properties front on the West 52<sup>nd</sup> Avenue and North Sheridan Boulevard, they are accessed via West 53<sup>rd</sup> Avenue, which is not within the project area. These properties are zoned C-4, and the comprehensive plan designation is Activity Center.

##### *Jefferson County (Unincorporated) & City of Arvada*

All the properties below contain the general plan designation Clear Creek I-76 IGA.

- The property at the northwest corner of North Sheridan Boulevard and West 52<sup>nd</sup> Avenue is an industrial or manufacturing land use. The property is zoned C-1 (Commercial) and P-D (Planned Development).
- To the west of this property is a mobile home park, containing relatively high-density single unit dwellings, which is zoned M-H (Mobile Home).
- To the west of the mobile home park are properties with industrial land uses, as well as an open space property at West 52<sup>nd</sup> Avenue and the Clear Creek. These areas are zoned I-2 (Heavy Industrial).

- West of I-76, there is a mixture of single unit dwelling (low density) residential land use as well as industrial land use, including warehouse/office land use. The parcels within unincorporated Jefferson County are zoned a mix of R-2, R-3, I-3 (Light Industrial), and P-D. The parcels within the City of Arvada are zoned Light Industrial (I-L), General Industrial (I-G), and Mixed-Use Suburban.

In summary, the project area contains large amounts of open space and single-unit residential land uses, with some multi-unit residential, industrial, institutional, and commercial land uses as well. For additional information please see **Appendix B** for the land use and zoning map.

SEH reviewed CCD mapping resources, as well as those of the following jurisdictions in the project area:

- Adams County (unincorporated)
- Jefferson County (unincorporated)
- City of Arvada

SEH prepared a map of the project area indicating land use, zoning, and municipal jurisdiction of each parcel fronting West 52<sup>nd</sup> Avenue and Sheridan Boulevard, attached as **Appendix B**. Each jurisdiction has different zoning, and Denver has two zoning codes (the 2010 Denver Zoning Code and Former Chapter 59) which apply to properties in the project area. There is limited correlation between the zoning regulations and district designations in these various jurisdictions. In general, zoning in the project area consists of large amounts of low-density single unit residential zoning and open space zoning. There are smaller amounts of multi-unit residential, industrial, institutional, commercial, and even agricultural zoning.

#### **D. Inventory of curb use and on-street parking**

SEH performed a visual inventory of on-street parking by block at 5 AM and 11 AM on a weekday (Thursday, July 30, 2020). A parking occupancy map is included as **Appendix C**. SEH calculated the percent occupancy based on 20' parallel parking spaces with no parking 20' from a curb ramp or intersection, nor within 10' of a fire hydrant or within 5' of a driveway or alley.

Parking occupancy was very light on the day surveyed, as class was not in session at Regis University. The only observed parking was on the south side of West 52<sup>nd</sup> Avenue between North Tennyson Street and North Lowell Boulevard. Anecdotal field visit evidence and historic Google street view maps indicate that parking occupancy on the south side of West 52<sup>nd</sup> Avenue between North Newton Street and North Lowell Boulevard can be much higher than observed when school is in session. Although not observed on the day that the parking inventory was conducted, previous visits have indicated some intermittent parking on West 52<sup>nd</sup> Avenue between North Sheridan Boulevard and Clear Creek, although there does not appear to be a consistent pattern of use.

SEH inventoried parking signs within the project and created a map of parking restrictions, which is also included in **Appendix C**. Parking is prohibited on North Sheridan Boulevard, as well as large portions of West 52<sup>nd</sup> Avenue.

The visual inventory did not identify any ADA/Loading zone parking spaces. Nor did the visual inventory and the land use analysis identify adjacent parking generation zones such as retail, churches, primary/secondary schools, or residents without off-street parking.

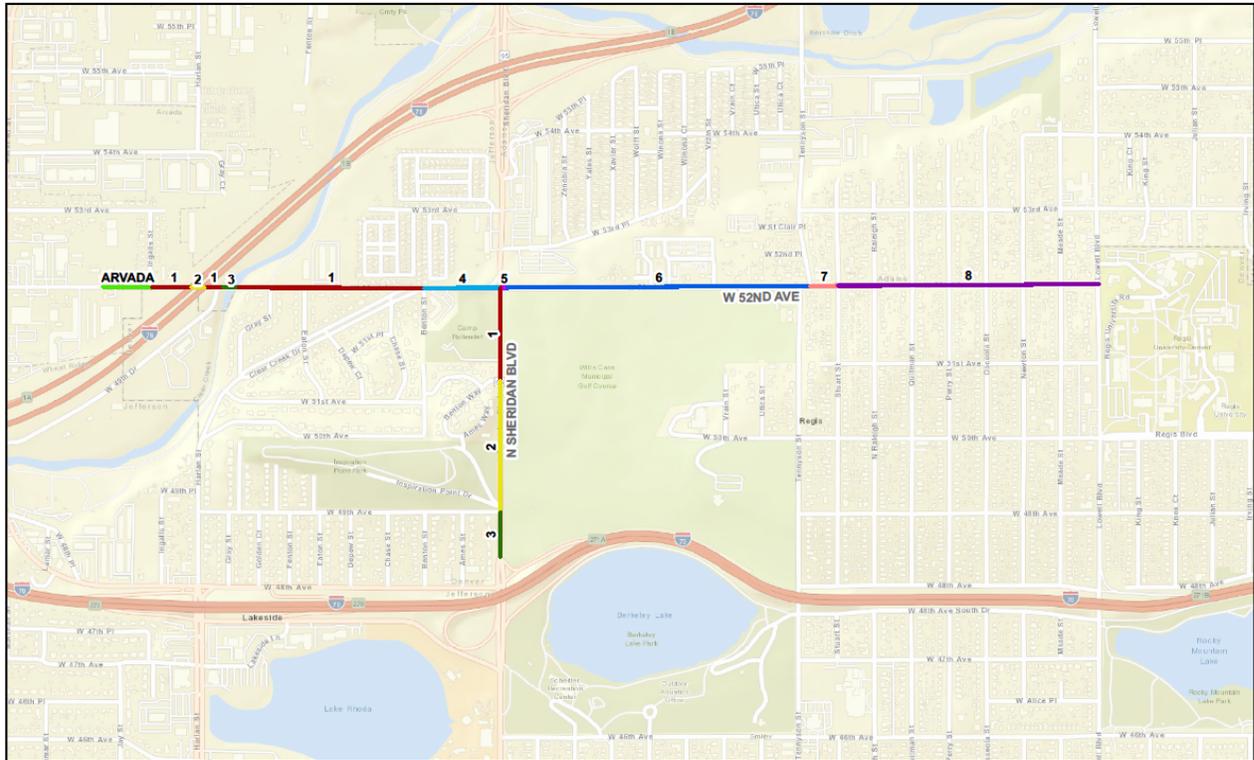
#### **E. Inventory of sidewalk gaps**

SEH has prepared a map showing areas with and without existing sidewalk. The map in **Appendix D** indicates the width of existing sidewalks and lists them as attached or detached. Attached sidewalks are intermittent along West 52<sup>nd</sup> Avenue, although most of what exists is on the Adams County side of the street. There is an attached sidewalk on a portion of the west side of North Sheridan Boulevard, although part of what exists is of substandard width.

## F. Existing street cross-sections

SEH has prepared existing street cross-sections that are representative of the corridor. Cross-sections have chosen sections to represent the different portions of the corridor. Figure 2 coincides with a Table 1 below and summarizes existing widths and their limits. Table 1 illustrates the differences between ROW and Flowline (for where there is an existing curb). This map of cross-sections locations and cross-sections is also included as **Appendix E**.

**Figure 2 – Existing Street Cross Section Locations**



**Table 1 Existing Street Cross Section Widths**

LOCATION	SECTION	EXISTING CROSS SECTION WIDTHS (FT)				
		FLOWLINE WIDTH	N ROW TO FLOWLINE WIDTH	S ROW TO FLOWLINE WIDTH	W ROW TO FLOWLINE WIDTH	E ROW TO FLOWLINE WIDTH
W 52ND AVE. (W OF INGALLS ST.)	Arvada	29.9	38.3	14.1	NA	NA
W 52ND AVE. (INGALLS ST. TO BENTON ST.)	1	25	16.9	17.4	NA	NA
W 52ND AVE. (UNDER I-76)	2	41.4	9	9.3	NA	NA
W 52ND AVE. (CLEAR CREEK BRIDGE)	3	45.3	7.51	6.5	NA	NA
W 52ND AVE. (BENTON ST. TO SHERIDAN BLVD.)	4	39.8	12.2	7.92	NA	NA
W 52ND AVE. (E OF SHERIDAN BLVD.)	5	43.9	22	4.2	NA	NA
W 52ND AVE. (E OF SHERIDAN BLVD. TO TENNYSON ST.)	6	37.8	12.4	9.7	NA	NA
W 52ND AVE. (TENNYSON ST. TO STUART ST.)	7	43.55	12.2	25.35	NA	NA
W 52ND AVE. (STUART ST. TO LOWELL BLVD.)	8	37.16	11.88	10.71	NA	NA
SHERIDAN BLVD. (52ND AVE. TO W 51ST AVE.)	S1	52.2	NA	NA	3.6	4.2
SHERIDAN BLVD. (W 51ST AVE. TO 49TH AVE.)	S2	47.6	NA	NA	6.4	6.2
SHERIDAN BLVD. (49TH AVE. TO I-70)	S3	52.8	NA	NA	13.9	3.5

### G. Inventory of existing traffic signal equipment

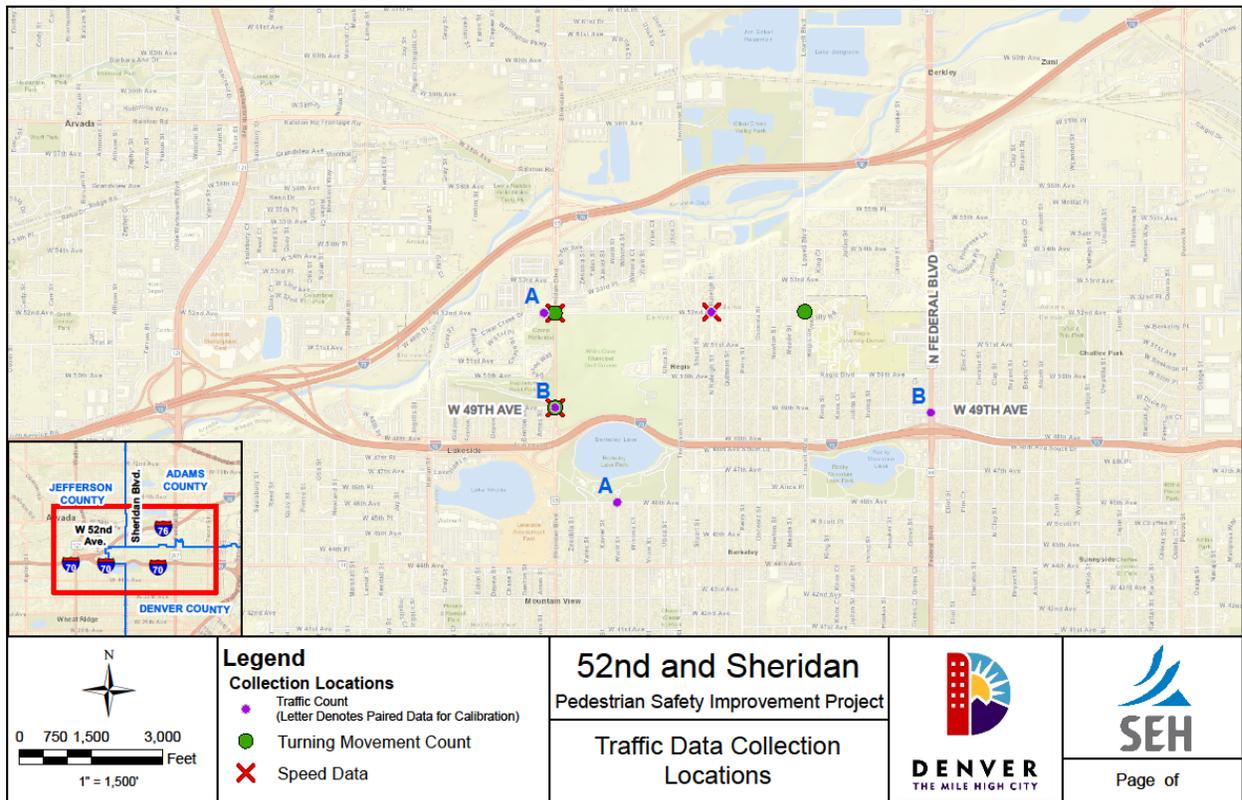
SEH visited the intersection of West 52<sup>nd</sup> Avenue and Sheridan Boulevard on July 30, 2020 and inventoried the signal heads, cameras, vehicle detection, and traffic control cabinet type. This information is presented below in Table 2.

**Table 2 Traffic Signal Equipment Inventory**

<b>Traffic Signal Equipment Inventory (Sheridan Boulevard &amp; West 52<sup>nd</sup> Avenue)</b>	
NW Corner	<b>(2)</b> Pedestrian Signal Heads, <b>(3)</b> 3-Section Traffic Signal Heads, <b>(1)</b> 4-Section Traffic Signal Head <b>(1)</b> CCTV, <b>(1)</b> EVP Unit, <b>(1)</b> FLIR Traffic Camera
NE Corner	<b>(2)</b> Pedestrian Signal Heads, <b>(4)</b> 3-Section Traffic Signal Heads, <b>(1)</b> 4-Section Traffic Signal Head, <b>(1)</b> EVP Unit, <b>(1)</b> FLIR Traffic Camera, <b>(1)</b> Traffic Signal Controller Cabinet (P-Type), <b>(1)</b> Electric Service Meter
SE Corner	<b>(2)</b> Pedestrian Signal Heads, <b>(3)</b> 3-Section Traffic Signal Heads, <b>(1)</b> 4-Section Traffic Signal Head, <b>(1)</b> FLIR Traffic Camera
SW Corner	<b>(2)</b> Pedestrian Signal Heads, <b>(4)</b> 3-Section Traffic Signal Heads, <b>(1)</b> 4-Section Traffic Signal Head, <b>(1)</b> FLIR Traffic Camera

### H. Travel counts — Speed, ADT, TMCs

SEH, through our subconsultant, All Traffic Data, conducted camera-based counts of average daily traffic at locations east, west, and south of the intersection of North Sheridan Boulevard and West 52<sup>nd</sup> Avenue. These locations approximately match the three locations defined by previous DRCOG counts. Figure 3 below shows the locations where speed, ADT, and turning movement information was collected. The summary information and analysis are presented below. The full count tables are included in **Appendix F**.



**Figure 3 – Traffic Data Collection Locations**

Collected data included classification counts along the corridors as shown in Table 3 below. The counts were conducted on August 11-12, 2020.

**Table 3 ADT Classification Counts**

Count Location	Traffic Direction	Total Traffic	Pedestrian & Bicycles		Heavy Vehicles (3 Axles or More)	
			Number	%	Number	%
52 <sup>nd</sup> E/O Sheridan	Eastbound	2524	34	1.3%	11	0.4%
	Westbound	2663	16	0.6%	22	0.8%
	Total	5187	50	1.0%	33	0.6%
52 <sup>nd</sup> W/O Raleigh	Eastbound	2587	28	1.1%	15	0.6%
	Westbound	2548	21	0.8%	23	0.9%
	Total	5135	49	1.0%	38	0.7%
Sheridan N/O 49 <sup>th</sup>	Northbound	15,122	70	0.5%	526	3.5%
	Southbound	13,658	49	0.4%	273	2.0%
	Total	28,780	119	0.4%	799	2.8%
Sheridan S/O 49 <sup>th</sup>	Northbound	15,790	114	0.7%	315	2.0%
	Southbound	14,430	105	0.7%	353	2.4%
	Total	30,220	219	0.7%	668	2.2%

## CALIBRATION

The City requested that ADT counts be calibrated due to the effect of COVID 19 on travel patterns, which had reduced traffic during the survey period. In an email dated June 25, 2020, Haley Johansen of DOTI outlined a preferred approach where counts taken during the pandemic would be compared to pre-COVID counts at the same locations, if such counts were available. This email is attached as **Appendix G1**. If previous counts were not available, the City recommended taking counts from a suitable comparison street. In concert with this direction from DOTI, SEH's approach for this project was outlined in a memo to James Colbert from Matthew Seubert dated July 24, 2020, and the City subsequently approved this approach in an email from James Colbert to Scott Jardine dated July 31. Both the memo and the email are included in **Appendices G2** and **G3**, respectively. Below please find a summary of the approach that was approved by the City.

**Subject Corridor: West 52<sup>nd</sup> Avenue**  
**Comparison Corridor: West 46<sup>th</sup> Avenue**

West 52<sup>nd</sup> Avenue has a mix of Industrial, Residential, Park, Institutional uses (University), and can be assumed to carry some freight traffic, especially west of North Sheridan Boulevard, as well as trips to Regis University east of N. Sheridan Boulevard. It has a two-lane section with left turn lanes and a signal only at North Sheridan Boulevard. These characteristics make it unique for the area. Counts were conducted on West 52<sup>nd</sup> Avenue by DRCOG east of North Sheridan Boulevard in 2013 and west of North Sheridan Boulevard in 2014.

For comparison, SEH looked at the following nearby streets, most of which were suggested by DOTI staff:

- **West 50<sup>th</sup> Avenue** between North Tennyson Street and North Lowell Boulevard, is somewhat similar to West 52<sup>nd</sup> Avenue in terms of lane configuration, land uses, block/intersection pattern (connectivity), access control/signalization, and University destination. However, there don't appear to be historic traffic counts for West 50<sup>th</sup> Avenue.  
*Recommendation:* Not a good comparison street as historic traffic data is not available.
- **North Pecos Street** was suggested as a potential comparison street by DOTI staff and is a north-south street 2.5 miles east of North Sheridan Boulevard (and 1.5 miles east of the terminus of West 52<sup>nd</sup> Avenue at Regis University). It has a mixed commercial and residential land use context and a two-lane cross section, similar to the subject street West 52<sup>nd</sup> Avenue. There are traffic counts available at Pecos and West 49<sup>th</sup> Avenue from DRCOG for 2013 (outside the recommended five-year window), although volumes are substantially higher than on West 52<sup>nd</sup> Avenue.  
*Recommendation:* Due to the distance from the project location, higher traffic volumes, the age of the data available, and differing cardinal direction, North Pecos Street was not recommended as a comparison street.
- **West 56<sup>th</sup> Avenue/Ralston Rd.** was suggested as a potential comparison street by DOTI staff and has somewhat similar industrial land use compared to West 52<sup>nd</sup> Avenue west of North Sheridan Boulevard. There is a count available from DRCOG for 2013 for West 56<sup>th</sup> Avenue east of Lamar Street, which is a two-lane section. However, this location is in Arvada and unincorporated Jefferson County and is also outside of DOTI's recommended five-year window.  
*Recommendation:* Not recommended as in a different jurisdiction and data is outside the five-year window.
- **West 48<sup>th</sup> Avenue** was suggested as a potential comparison street by DOTI staff but is dissimilar in lane configuration (four lanes), land uses, destinations, connectivity, and function (it functions in part as a freeway feeder). Destinations are not especially similar. However, DRCOG counts are available east of North Gray Street for 2018.  
*Recommendation:* Although data is available, the land uses, lane configuration, destinations, connectivity, and function are different. Although it may be an acceptable comparison street, it is quite different from the subject street and is therefore not the recommended comparison street.
- **West 46<sup>th</sup> Avenue** is similar in terms of lane configuration (two lanes, although it does have a buffered bike lane), and some land uses (park and residential), although it does not have industrial land uses. Connectivity is somewhat different as the street ends at North Sheridan Boulevard, and destinations are not

similar, however signalization and lack of access control are similar to West 52<sup>nd</sup> Avenue. There are counts from DRCOG west of North Wolff Street (2016) and west of North Raleigh Street (2015).

*Recommendation:* Similarities in some land uses, lane configuration, and signalization/access control warrant consideration as an acceptable comparison street, even though destinations and connectivity are different.

Although there is no obvious ‘apples to apples’ comparison street for West 52<sup>nd</sup> Avenue, since it is similar to the subject street in terms of land use, lane configuration, and signalization, and data is available, **SEH recommended West 46<sup>th</sup> Avenue as a suitable comparison street to West 52<sup>nd</sup> Avenue.**

**Project Corridor: North Sheridan Boulevard**  
**Comparison Corridor: North Federal Boulevard**

North Sheridan Boulevard is a state highway that can be assumed to carry a mix of regional and local traffic, as well as substantial freight traffic. North Federal Boulevard is a state highway 1.5 miles east that can be assumed to also carry a mix of regional and local traffic, with substantial freight traffic. They have a similar five lane configuration, although North Federal Boulevard has more commercial use, whereas North Sheridan Boulevard has a combination of park, residential, and industrial/commercial use. They both have a similar connectivity to I-70 and other east/west collector streets. Destinations are not similar although they both connect to I-70. North Federal Boulevard borders Regis University, while North Sheridan Boulevard doesn't. They are both signalized with little access control (mostly no medians with left turns allowed - although North Sheridan Boulevard does have some medians). Overall, these two share some similarities and North Federal Boulevard is a good ‘apples to apples’ comparison street for North Sheridan Boulevard.

On North Sheridan Boulevard, there are CDOT counts from 2018 at West 49<sup>th</sup> Avenue. North Federal Boulevard has a similar ADT to North Sheridan Boulevard for 2018 as measured by CDOT at West 49<sup>th</sup> Avenue. North Federal Boulevard has somewhat higher traffic volumes than North Sheridan Boulevard. For the comparison, traffic volumes could be measured on North Federal Boulevard at West 49<sup>th</sup> Avenue and compared to the 2018 figures for the same location. The difference between the two figures could then be used to verify the difference between the 2020 and 2018 figures for North Sheridan Boulevard at West 49<sup>th</sup> Avenue.

SEH recommended comparison traffic counts be completed for the project street at North Sheridan Boulevard and West 49<sup>th</sup> Avenue and the comparison street at North Federal Boulevard and West 49<sup>th</sup> Avenue.

Therefore, the locations surveyed and the locations which were chosen and approved as comparison streets were:

- West 52<sup>nd</sup> Avenue W/O North Raleigh Street
- West 52<sup>nd</sup> Avenue E/O North Sheridan Boulevard (comparison location: North 46<sup>th</sup> Avenue W/O North Wolff Street)
- North Sheridan Boulevard S/O West 49<sup>th</sup> Avenue (comparison location: North Federal Boulevard S/O West 49<sup>th</sup> Avenue)

Below please find an analysis of the calibration results as well as a summary and analysis of the travel counts.

**ADT**

Traffic counts were performed by All Traffic Data (ATD) on Tuesday, August 11, 2020 and Wednesday, August 12, 2020. In order to compare data with pre-COVID 19 numbers past Average Daily Traffic (ADT) taken from DRCOG were observed to create a more realistic picture of the corridors without the current anomaly effects of COVID 19 on traffic patterns. In Table 4 below lists selected locations and historic patterns from DRCOG. Table 5 shows the comparison of the historic patterns and the data collected in August 2020, while Table 6 summarizes the changes between the historic and the recently collected data.

**Table 4 Historic Average Daily Traffic (ADT)**

<b>Historic ADT</b>			
<b>Location</b>	<b>ADT</b>	<b>Traffic Count Date</b>	<b>Source</b>
46 <sup>th</sup> Ave W/O Wolff St	5,564	March, 2016	DRCOG
46 <sup>th</sup> Ave W/O Raleigh St	4,603	April, 2015	DRCOG
52 <sup>nd</sup> Ave E/O Sheridan Blvd	5,774	July, 2013	DRCOG
52 <sup>nd</sup> Ave W/O Sheridan Blvd	7,389	May, 2014	DRCOG
Sheridan Blvd S/O 49 <sup>th</sup> Ave	31,237	October, 2018	DRCOG
	32,670	August, 2019	DRCOG
Federal Blvd S/O 49 <sup>th</sup> Ave	38,574	October, 2018	DRCOG
	39,511	August, 2019	DRCOG

**Table 5 ADT Comparison**

<b>Average Daily Traffic (ADT) Comparison</b>			
<b>Location</b>	<b>ADT</b>	<b>Traffic Count Date</b>	<b>Source</b>
Sheridan Blvd S/O 49 <sup>th</sup> Ave	32,670	August, 2019	DRCOG
	30,220	August 12, 2020	All Traffic Data
Federal Blvd S/O 49 <sup>th</sup> Ave	39,511	August, 2019	DRCOG
	28,850	August 12, 2020	All Traffic Data
52 <sup>nd</sup> Ave E/O Sheridan Blvd	5,774	July, 2013	DRCOG
	5,187	August 12, 2020	All Traffic Data
46 <sup>th</sup> Ave W/O Wolff St	5,564	March, 2016	DRCOG
	4,411	August 12, 2020	All Traffic Data
52 <sup>nd</sup> Ave W/O Raleigh St	5,045	August 12, 2020	All Traffic Data
46 <sup>th</sup> Ave W/O Raleigh St	4,603	April, 2015	DRCOG

## ADT Calibration

Table 6 below lists the historical ADT volumes gathered from DRCOG as well as the existing ADT volumes gathered by All Traffic Data.

**Table 6 ADT Comparison and Changes**

Average Daily Traffic (ADT) Comparison				
Location	August 2019 (DRCOG)	August 2020 (All Traffic Data)	Δ ADT	% Decrease
N Sheridan Boulevard S/O W 49 <sup>th</sup> Ave	32,670	30,220	2,450	8.1%
N Federal Blvd S/O W 49 <sup>th</sup> Ave	39,511	28,850	10,661	37.0%
	May 2013 (DRCOG)	August 2020 (All Traffic Data)		
W 52 <sup>nd</sup> Ave E/O N Sheridan Blvd	5,774	5,187	587	11.3%
	March 2016 (DRCOG)	August 2020 (All Traffic Data)		
W 46 <sup>th</sup> Ave W/O N Wolff St	5,564	4,411	1,153	26.1%

### Sheridan Boulevard Calibration:

According to the traffic count conducted in August 2020, the ADT for North Sheridan Boulevard declined by 2,450 vehicles from August 2019 representing an 8.1% decrease in traffic. The comparison corridor, North Federal Boulevard, displayed a 37.0% decrease in ADT. The proximity of North Federal Boulevard to downtown Denver and density of residential homes in the vicinity of the comparison area along North Federal Boulevard may be a factor contributing to the much larger loss in daily commuter traffic. We believe a 37% decrease in ADT is not representative of the effects COVID-19 has had on the North Sheridan Boulevard corridor and cannot justify a 37% increase. Furthermore, the project area along the North Sheridan Boulevard corridor is built-out and is not expected to see a large increase in future ADT. According to CDOT's Online Transportation Information System, the 20-year growth factor for the location on North Sheridan Boulevard south of West 49<sup>th</sup> Avenue is 1.03, approximately 0.15% per year.

Due to the small growth rate, the expected ADT should have been closer to year 2019 ADT without any COVID-19 impacts. **Therefore, our conclusion is that an 8.5% increase to ADT along Sheridan Boulevard is sufficient to account for COVID-19 impacts.**

### West 52<sup>nd</sup> Avenue Calibration:

According to the traffic count conducted in August 2020, the ADT for West 52<sup>nd</sup> Avenue declined by 587 vehicles from May 2013 representing a 10.2% decrease in traffic. The comparison corridor, West 46<sup>th</sup> Avenue, displayed a 20.7% decrease in ADT from March 2016 to August 2020. Each corridor is built-out, with West 46<sup>th</sup> Avenue located in a more residentially dense area than the study area for West 52<sup>nd</sup> Avenue and is expected to display a larger decrease in ADT due to COVID-19.

Due to the minimal impacts of growth on ADT, the count from year to year should be relatively the same with small amounts of growth each year. Applying the same growth rate used for North Sheridan Boulevard to West 52<sup>nd</sup> Avenue (0.15% per year), the adjusted ADT for West 52<sup>nd</sup> Avenue from March 2013 to August 2020 is approximately 5,850, which would represent approximately 13% decrease in ADT due to COVID-19. **Our conclusion is that a 13% increase to ADT along West 52<sup>nd</sup> Avenue is sufficient to account for COVID-19 impacts.**

Table 7 below represents the calibrated ADT volumes for the North Sheridan Boulevard and West 52<sup>nd</sup> Avenue corridors:

**Table 7 ADT Calibration Volumes**

Average Daily Traffic (ADT) Calibration Volumes					
Location	August 2019 (DRCOG)	*August 2020 (Adjusted)	August 2020 (ATD)	Calibration Factor	Calibrated ADT Volume
N Sheridan Blvd S/O W 49 <sup>th</sup> Ave	32,670	32,719	30,220	8.5%	<b>32,789</b>
	May 2013 (DRCOG)	*August 2020 (Adjusted)	August 2020 (ATD)		
W 52 <sup>nd</sup> Ave E/O N Sheridan Blvd	5,774	5,837	5,187	13.0%	<b>5,861</b>
*0.15% growth factor applied to grow historical ADT value to August, 2020					

Please see Table 3 for the classification counts discussed in the following paragraphs.

**Pedestrians/Bicyclists**

Eastbound traffic along West 52<sup>nd</sup> Avenue east of North Sheridan Boulevard has an ADT of 2,524 with 34 (1.3%) pedestrians or bicyclists counted. Westbound volumes for this same area counted a total of 2,663 with 16 (0.6%) pedestrians or bicyclists counted. Counts were also done along West 52<sup>nd</sup> Avenue west of North Raleigh Street: the total ADT for eastbound traffic were 2,587 with 28 (1.1%) pedestrians or bicyclists counted. For westbound an ADT of 2,548 with 21 (0.8%) accounting for pedestrians or bicyclists was obtained. Eastbound has slightly higher pedestrian numbers than westbound along West 52<sup>nd</sup> Avenue.

Northbound traffic along North Sheridan Boulevard north of West 49<sup>th</sup> Avenue has an ADT of 15,122 with 70 (0.5%) pedestrians or bicyclists counted. Southbound ADT for this same area was 13,658 with 49 (0.4%) pedestrians or bicyclists. Counts were also done along North Sheridan Boulevard south of West 52<sup>nd</sup> Avenue. The total ADT was 15,790 with 114 (0.7%) pedestrians or bicyclists counted. For southbound an ADT of 14,430 total vehicles counted with 105 (0.7%) accounting for pedestrians or bicyclists. Northbound sees slightly heavier foot traffic than southbound along North Sheridan Boulevard.

Figure 4 is a screen shot of a Strava heat map of bicycle activity. The highest amount of bicycle activity within the project area on Strava are the Clear Creek Trail and connecting surface streets, North Tennyson Street, and North Lowell Boulevard. There is lower recorded bicycle activity on West 52<sup>nd</sup> Avenue, and very little on North Sheridan Boulevard north of West 48<sup>th</sup> Avenue. Strava data reflects only a subset of people who bicycle, primarily recreational cyclists, and may not include people biking for other purposes, such as commuting to work or school. Strava data may also not be representative demographically of all people who bicycle, for example not including younger riders such as children.



**Figure 4 – Strava Heat Map of Bicycling**

## Heavy Vehicles

Eastbound traffic along West 52<sup>nd</sup> Avenue east of North Sheridan Boulevard has an ADT of 2,524 with 11 (0.4%) heavy vehicles with three or more axles counted. Westbound volumes for this same area counted a total of 2,663 with 22 (0.8%) heavy vehicles counted. Counts were also done along West 52<sup>nd</sup> Avenue west of North Raleigh Street. The total count for eastbound traffic was 2,587 with 15 (0.6%) heavy vehicles counted and for westbound a total of 2,548 total vehicles counted with 23 (0.9%) accounting for heavy vehicles.

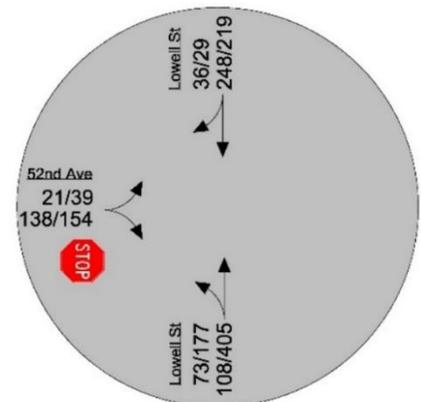
North Sheridan Boulevard is a designated truck route; heavy vehicles are expected to have a higher percentage than on West 52<sup>nd</sup> Avenue. Northbound traffic volume along North Sheridan Boulevard north of West 49<sup>th</sup> Avenue has a daily total of 15,122 with 526 (3.5%) heavy vehicles with three or more axles. Southbound volumes for this same area counted a total of 13,658 with 273 (2.0%) heavy vehicles. Counts were also done along North Sheridan Boulevard south of West 52<sup>nd</sup> Avenue; the total count for northbound traffic was 15,790 with 315 (2.0%) heavy vehicles counted and for southbound a total of 14,430 total vehicles counted with 353 (2.4%) accounting for heavy vehicles.

## Turning Movement Counts

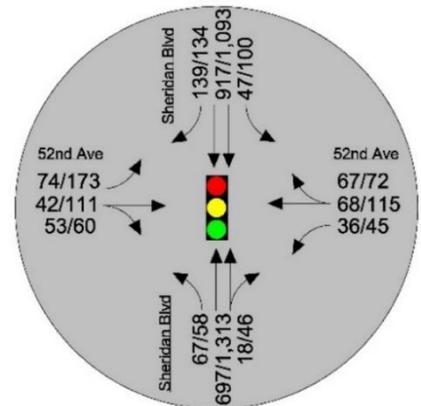
Turning Movement Counts were conducted by All Traffic Data on Tuesday, August 11, 2020 during the morning and evening peak hours. Below in Figure 5 are traffic bubbles illustrating the existing lane configuration and peak hour turning movement volumes (AM Peak/PM Peak).

Figure 5 - Turning Movement Counts

**52<sup>nd</sup> & Lowell** – The morning peak hour occurs from 7:00-8:00 AM, and evening peak hour occurs from 4:30-5:30 PM. Eastbound right turning vehicles from West 52<sup>nd</sup> Avenue to North Lowell Boulevard represents the largest movement from West 52<sup>nd</sup> Avenue. Through movement vehicles represent the majority along North Lowell Boulevard Northbound traffic is higher in the PM peak hour with a larger number of left turns present as well. Southbound traffic is similar for both AM and PM peak hours.



**Sheridan & 52<sup>nd</sup>** – The morning peak hour occurs from 7:30-8:30 AM, and the evening peak hour occurs from 4:30-5:30 PM. The major movements include through movement traffic along North Sheridan Boulevard West 52<sup>nd</sup> Avenue displays major movements for through movement vehicles, as well as eastbound left turning vehicles. Overall, the intersection has more traffic during the PM peak hour. Northbound and westbound traffic nearly doubles in the PM peak hour. Southbound traffic displays a slightly higher PM peak hour for through traffic and more than doubles for left turning vehicles in the PM peak.



**Sheridan & 49<sup>th</sup>** – The morning peak hour occurs from 7:30-8:30 AM, and the evening peak hour occurs from 4:30-5:30 PM. The majority of vehicles are through movement along North Sheridan Boulevard. Traffic from West 49<sup>th</sup> Avenue is minimal with more right turning vehicles than left turning. Overall, the intersection sees an increase of traffic during the PM peak hour. Northbound North Sheridan Boulevard nearly doubles in the PM peak and southbound shows an increase as well during the PM peak.

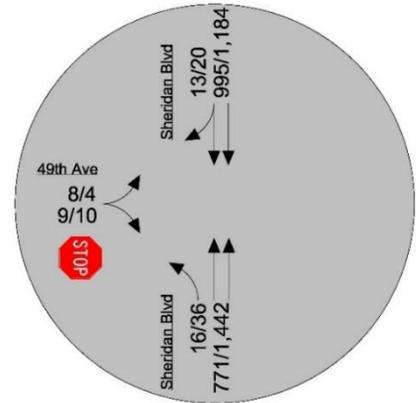
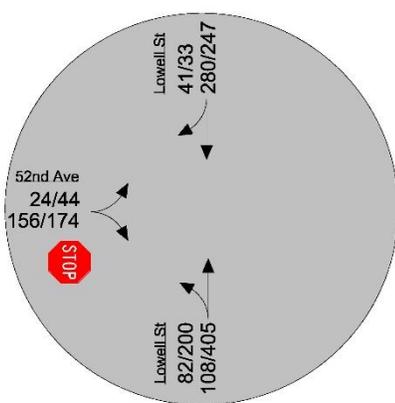
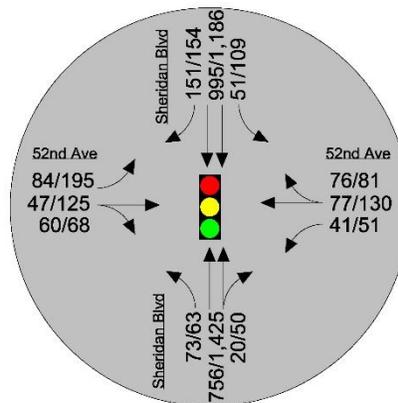


Figure 5b below represents the calibrated peak hour volumes with an 8.5% growth applied to the Sheridan Boulevard corridor and 13% growth applied to the West 52<sup>nd</sup> Avenue corridor.

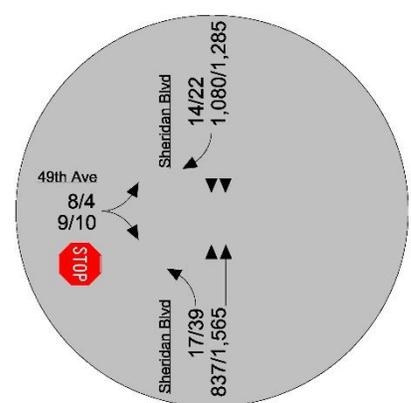
**Figure 5b - Calibrated Turning Movement Counts**



**52<sup>nd</sup> & Lowell**



**Sheridan & 52<sup>nd</sup>**



**Sheridan & 49<sup>th</sup>**

**SPEED**

Speed studies were conducted for the North Sheridan Boulevard and West 52<sup>nd</sup> Avenue corridors. The results of the study are shown in Table 8 below:

**Table 8 Speed Data**

Speed Data (collected August 2020)					
Location	Direction	Posted Speed Limit (MPH)	Average Speed (MPH)	85th Percentile Speed (MPH)	Δ 85% & Posted Speed (MPH)
Sheridan Blvd N/O 49 <sup>th</sup> Ave	NB	35	31	37	2
	SB	35	34	42	7
Sheridan Blvd S/O 49 <sup>th</sup> Ave	NB	35	33	39	4
	SB	35	32	42	7
52 <sup>nd</sup> Ave E/O Sheridan Blvd	EB	30	30	35	5
	WB	30	32	38	8
52 <sup>nd</sup> Ave W/O Raleigh St	EB	30	26	29	-1
	WB	30	28	33	3

North Sheridan Boulevard speeds were gathered at a location north of West 49<sup>th</sup> Avenue, and at a location south of West 49<sup>th</sup> Avenue. West 52<sup>nd</sup> Avenue speeds were gathered east of North Sheridan Boulevard and west of North Raleigh Street. The southbound direction on North Sheridan Boulevard and westbound direction on West 52<sup>nd</sup> Avenue display the highest reported speeds for each corridor. The 85<sup>th</sup> percentile speed reported 7 mph higher than the posted speed limit for southbound North Sheridan Boulevard and 8 mph higher than the posted speed limit on westbound West 52<sup>nd</sup> Avenue just east of North Sheridan Boulevard, indicating that speeding may be an issue in the area.

#### **I. RTD boarding and alighting data**

SEH contacted RTD to obtain bus boarding and alighting data. This information is presented in **Appendix H**. There are eight stops on West 52<sup>nd</sup> Avenue (Route 52) and three on North Sheridan Boulevard (Route 51). The bus stops with the highest number of boardings and alightings in the project area are all in the vicinity of West 52<sup>nd</sup> Avenue and North Sheridan Boulevard. In order, they are:

1. North Sheridan Boulevard at West 52<sup>nd</sup> Avenue (143 daily boardings and alightings in both directions)
2. West 52<sup>nd</sup> Avenue at North Sheridan Boulevard (107)
3. West 52<sup>nd</sup> Avenue at Benton Way (38)

All other stops had 25 or fewer boardings and alightings. An email from Dan Merritt, Service Planner for RTD, dated February 10, 2020, states that RTD is considering removal of one of the low ridership stops at North Sheridan Boulevard and West 49<sup>th</sup> Avenue, which only had two boardings and alightings (see **Appendix L** of the full Project Status Report for this email).

#### **J. Crash data from CCD's VisionZero crash database**

SEH obtained crash data for the most recent 5-years from CCD's Vision Zero crash database for the five years spanning March 1, 2015 through February 28, 2020. The data was then analyzed for each corridor based on crashes by year, roadway condition, location, severity and type. The crashes were also plotted on a heat map to show hot spots along the corridor, which is included in **Appendix I**.

### **CRASH ANALYSIS**

#### ***Sheridan Boulevard***

North Sheridan Boulevard is a five-lane divided highway with hills and a speed limit of 35 MPH in the area of this study. Crashes along North Sheridan Boulevard for the five-year period showed 86 total crashes of which one involved a bicycle and one a pedestrian. Year five (March 1, 2019 through February 28, 2020) had the most crashes with 25.6% during that time period.

Intersection crashes were 41% of the crashes and non-intersection crashes were 45% of total crashes. Property damage only accounted for most of the crashes with 95% of total crashes. However, there were also three injury crashes and one fatality were noted as well.

The crash type distribution had normal patterns in the sense rear end crashes were the most prevalent, 34 (40.5%) of total crashes followed by sideswipe crashes representing 22 (26.2%) of total crashes. Concerning patterns include the presence of broadside crashes which represent 7 (8.3%) of total crashes and head on type crashes with 2 (2.4%) of total crashes due to their potential for higher severity results. Also present was one (1.2%) crash involving a bicycle and one (1.2%) involving a pedestrian.

One fatality and three injury type crashes were recorded on North Sheridan Boulevard during the timeframe data was analyzed. The one fatality involved a pedestrian travelling west hit by a vehicle travelling south at West 48<sup>th</sup> Avenue and North Sheridan Boulevard. The injury crashes include one rear end heading south along North Sheridan Boulevard in the 5100 block. Another crash resulting in injury was a fixed object (wall) type crash northbound in the 5000 block of North Sheridan Boulevard. The third injury type crash recorded was the result of an approach turn type crash at the intersection of West 48<sup>th</sup> Avenue and North Sheridan Boulevard (northbound left turn and southbound through).

In addition to the crashes discussed above there was one fatal crash outside the five-year time frame of the Vision Zero database. The crash occurred in January 2014 during icy conditions at the intersection of West

52<sup>nd</sup> Avenue and North Sheridan Boulevard and involved a head on collision between two vehicles traveling on North Sheridan Boulevard. This crash is noted on the map in **Appendix I** along with the other fatality and serious injury crashes.

The area just north of I-70 on North Sheridan Boulevard at West 48<sup>th</sup> Avenue had the highest crash frequency along the corridor. West 48<sup>th</sup> Avenue serves as frontage road to I-70 and is in close proximity to the Sheridan Boulevard interchange with I-70. The intersection is signalized. Other areas that demonstrate a high crash frequency are located at the intersection of West 52<sup>nd</sup> Avenue and North Sheridan Boulevard as well as along the corridor between Benton Way and West 52<sup>nd</sup> Avenue. A medium crash frequency was noted at North Sheridan Boulevard's intersection with West 49<sup>th</sup> Avenue and the corridor between West 49<sup>th</sup> Avenue and Benton Way.

### **West 52<sup>nd</sup> Avenue**

West 52<sup>nd</sup> Avenue is a two-lane roadway with a speed limit of 30 MPH within the project limits. West 52<sup>nd</sup> Avenue for the five-year period had 43 total crashes of which none involved a bicycle or pedestrian. Year one (March 1, 2015 through February 28, 2016) had the most crashes with 14 (32.6%) of the total crashes during that time period.

Intersection crashes were 46.5% of the crashes and non-intersection crashes were 34.9% total crashes. The crash type distribution showed rear end crashes as most prevalent, 18 (41.9%) of total crashes, followed by sideswipe crashes representing 8 (18.6%) of total crashes. Broadside crashes closely follow the number of sideswipes with 7 (16.3%) of total crashes; this crash type has potential for higher severity results. In addition to the intersection of West 52<sup>nd</sup> Avenue and Sheridan Boulevard, discussed above, a moderately high frequency was observed at the offset intersection of West 52<sup>nd</sup> Avenue and North Tennyson Street. There were no fatal or serious injury crashes on West 52<sup>nd</sup> Avenue other than the fatality crash noted above at West 52<sup>nd</sup> Avenue and North Sheridan Boulevard.

### **Conclusions**

The areas along North Sheridan Boulevard that show a high frequency of crashes include three intersections, one of which is not signalized, and the corridor areas between West 52<sup>nd</sup> Avenue and Benton Way as well as the corridor area between Benton Way and West 49<sup>th</sup> Avenue. Most crashes were rear end and sideswipe type crashes, however a pattern of broadside crashes were also noted, six of which were located at the signalized intersection of West 48<sup>th</sup> Avenue and North Sheridan Boulevard, where the interchange of I-70 meets West 48<sup>th</sup> Avenue as a frontage road. West 52<sup>nd</sup> Avenue had a high frequency of crashes located at the intersection of West 52<sup>nd</sup> Avenue and North Sheridan Boulevard. Another moderate high frequency area was located at the intersection of West 52<sup>nd</sup> Avenue and North Tennyson Street. Most crashes were rear end and sideswipe type crashes; however a pattern of broadside crashes was also noted, four of which were located at the signalized intersection of West 52<sup>nd</sup> Avenue and North Sheridan Boulevard. **Attachment I** contains the summary and analysis of this information along with a heat map of crashes.

## **K. Corridor map with existing and planned bike routes**

### **West 52<sup>nd</sup> Avenue**

SEH contacted CCD bike planners and requested information on existing and planned bike routes. The Denver Moves Bicycles [website](#) recommends a (standard) bike lane along West 52<sup>nd</sup> Avenue. Initial discussion with CCD bike planners indicated that the facility along West 52<sup>nd</sup> Avenue should be a buffered bike lane, rather than a standard bike lane.

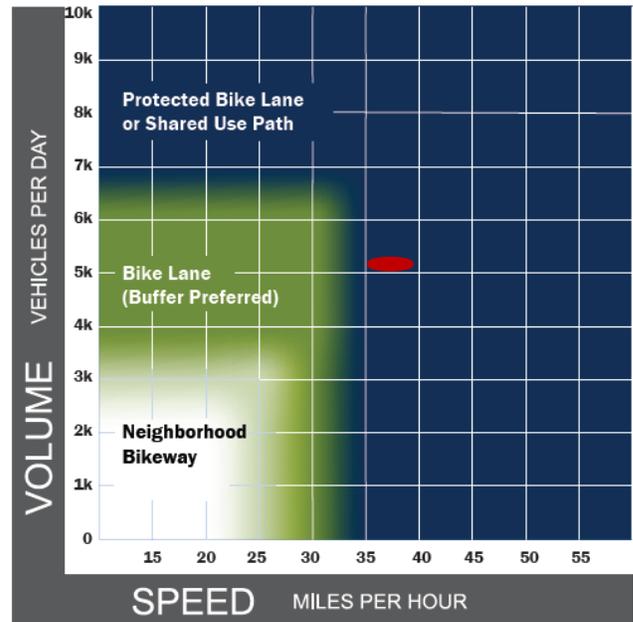
Subsequent to these initial conversations and analysis, SEH conducted traffic volume and speed counts on the subject streets in August 2020. For West 52<sup>nd</sup> Avenue, the surveyed ADT volumes were 5187 east of North Sheridan Boulevard, and 5045 west of North Raleigh Street. Observed 85<sup>th</sup> percentile speeds on West 52<sup>nd</sup> Avenue east of North Sheridan Boulevard were 38 mph westbound and 35 mph eastbound. West of North Raleigh Street observed 85<sup>th</sup> percentile speeds were 33 mph westbound and 29 mph eastbound.

The Bikeway Facilities Manual pending adoption by CCD includes a Bicycle Facility Selection Chart (labeled Figure 6 in the Manual and below) that outlines recommended bicycle facilities based on a combination of

observed volume and speed. Although the speed for the area west of North Raleigh Street indicates that a buffered bike lane is the recommended facility, the combination of volume and speed for the section of West 52<sup>nd</sup> Avenue east of North Sheridan Boulevard indicates that a protected bike lane or shared use path would be the preferred facility (see Figure 6 with observed ADT and 85<sup>th</sup> percentile speed on West 52<sup>nd</sup> Avenue east of North Sheridan Boulevard shown in red oval). The higher calibrated traffic volumes discussed in Section H above would also be consistent with a recommendation for protected bike lane or shared use path.

Figure 6 – Bicycle Facility Selection Chart

SEH evaluated the shared use path possibility on West 52<sup>nd</sup> Avenue using a fatal flaw analysis. A shared use path would be possible to build on the south side of West 52<sup>nd</sup> Avenue between North Sheridan Boulevard and North Tennyson Street, as this area is part of the Willis Case Golf Course and does not contain structures. However, coordination with the Parks and Recreation Department would be necessary. The remainder of the West 52<sup>nd</sup> Avenue corridor is along private property and contains fences, driveways, and parking areas where a potential shared use path might be located. Another option would be to construct an on street protected bike lane on West 52<sup>nd</sup> Avenue except for the portion between North Sheridan Boulevard and North Tennyson Street. However, this would require that bicyclists move from an on-street facility at North Sheridan Boulevard to a shared use path between North Sheridan Boulevard and North Tennyson Street, and then back to an on-street facility at North Tennyson Street. This switching between facilities would be complicated for both bicyclists and motorists. The cost of obtaining needed right of way or easements would add costs, the cost to construct a shared use path would likely be higher than an on-street facility, and the required coordination more complex compared to an on-street facility. Based on this fatal flaw analysis, SEH does not recommend a shared use path on West 52<sup>nd</sup> Avenue.



Notes

- 1 Chart assumes operating speeds are similar to posted speeds. If they differ, use operating speed rather than posted speed.
- 2 Shared lanes may also be implemented using the same general speed and volume thresholds as neighborhood bikeways; however, shared lanes are a design tool and not an official Denver bicycle facility type. Please refer to Volume 2 of this Manual for their application.

Figure 6: Bicycle Facility Selection Chart

Based on the data collected in the traffic speed and volume study completed in August 2020, fatal flaw analysis, roadway section, and subsequent conversations with DOTI staff, the recommended facility for West 52<sup>nd</sup> Avenue has been changed to a protected bike lane, rather than a buffered bike lane. This would include a vertical barrier of a type to be determined.

SEH has prepared an overall map of the project area illustrating the existing and the West 52<sup>nd</sup> Avenue planned bike route, included as **Appendix J1**. The proposed protected bike lane along West 52<sup>nd</sup> Avenue is depicted on this map. The City, as part of a separate project, is also proposing a two-way protected bike lane on the southbound side of North Lowell Boulevard that would intersect the proposed bicycle facility on West 52<sup>nd</sup> Avenue. The City’s concept for the intersection of West 52<sup>nd</sup> Avenue and North Lowell Boulevard is shown in **Appendix J2**. Denver is also proposing a connection from the Clear Creek Trail on the north side of West 52<sup>nd</sup> Avenue to connect across West 52<sup>nd</sup> Avenue with a bike lane on North Gray Street. This will provide an improved bicycle connection to the Clear Creek Trail from this area of the Regis neighborhood. The 60% concept design plans are shown in **Appendix J3**. Arvada has also developed a Clear Creek Corridor Plan which identifies a proposed connection of the Creek Trail between existing segments to the north and south of West 52<sup>nd</sup> Avenue. Completion of this connection would require property acquisition in the

Clear Creek floodplain. The City and County of Denver has indicated that it is unlikely to pursue property acquisition to complete this connection at this time.

### North Sheridan Boulevard

The Denver Moves Bicycles [website](#) recommends a shared use path on the east side of Sheridan Boulevard between West 48<sup>th</sup> and 49<sup>th</sup> Avenues. The observed 85<sup>th</sup> percentile speed for North Sheridan Boulevard was between 37 and 42 mph, and the observed ADT was between 28,780 and 30,220. The observed ADT exceeds that shown in the bicycle facility selection chart shown in Figure 6 above of the Bikeway Design Manual, meaning that a protected bike lane or a shared use path would be the recommended facility. Due to right of way constraints, existing travel lane configuration, the heavy traffic volumes, and high speeds SEH does not recommend a protected bike lane on this portion of North Sheridan Boulevard. CCD guidelines found in the Denver Bikeway Design Manual, and the roadway section, posted speed limits, and ADT counts noted in the sections above, support installation of a detached, grade separated shared use path on North Sheridan Boulevard. Availability of right-of-way, impacts to existing landscape features, CCD's Willis Case Golf course and other project constraints will need to be taken into account.

The Denver Moves bicycle plan, updated in 2015, indicates a proposed shared use path along the east side of North Sheridan Boulevard between West 48<sup>th</sup> and West 49<sup>th</sup> Avenues. As SEH developed the roadway cross-section alternatives for this project it was noted that buildout of this proposed facility would result in a shared use path that would end at West 49<sup>th</sup> Avenue. Future development plans would address extending the bicycle network west along West 49<sup>th</sup> Avenue through the adjacent residential neighborhood. However, a safe pedestrian and bicycle crossing of North Sheridan Boulevard was not addressed. At the West 49<sup>th</sup> Avenue termination point of the shared use path on Sheridan, bicyclists would have two options:

- 1) Continue along the east side of North Sheridan Boulevard to crosswalks at West 48<sup>th</sup> Avenue or West 52<sup>nd</sup> Avenue, either using a proposed sidewalk on the east side, or in the roadway with vehicular traffic. However, the proposed 5' wide sidewalk on the east side of North Sheridan Boulevard does not meet minimum width design standards for a shared use sidewalk or shared use path and riding a bicycle in traffic on North Sheridan Boulevard is not a high comfort option given vehicle speed and volume on that street.
- 2) The second option would be to cross North Sheridan Boulevard at West 49<sup>th</sup> Avenue. However, DOTI staff indicated that installing a HAWK signal at West 49<sup>th</sup> Avenue for bicyclists and pedestrians to cross North Sheridan Boulevard so close to the existing signal at West 48<sup>th</sup> Avenue would not be appropriate.

After consultation with DOTI staff, SEH recommends and DOTI concurs that the proposed shared use path should end at West 48<sup>th</sup> Avenue. Please see **Appendix J4** for the relevant correspondence from DOTI. The one block of the shared use path currently proposed on the Denver Moves plan on the east side of North Sheridan Boulevard between West 48<sup>th</sup> and West 49<sup>th</sup> Aves. (as well as the one block of proposed bike lane on West 49<sup>th</sup> Avenue between North Ames Street and North Sheridan Boulevard) can be removed from that plan if approved by DOTI management. Bicyclists would instead be able to cross North Sheridan Boulevard at the signalized intersection at West 48<sup>th</sup> Avenue and then utilize a proposed on-street bike facility on West 48<sup>th</sup> Avenue and North Ames Street to link to the proposed bike lane on West 49<sup>th</sup> Avenue. This routing is in fact reflected in the Strava heat map of the area (see Figure 4). The proposed bicycle facility on West 49<sup>th</sup> Avenue provides a connection to Inspiration Point Park and neighborhood and to the Clear Creek multi-use trail.

### III. DESIGN DECISIONS/ CONSIDERATIONS

#### A. ADA Compliance

The City and County of Denver's current Transportation Standards and Details from April 2017 outline construction requirements for new curb ramps. These are intended to comply with the Department of Justice's revised regulations for Titles II and III of the Americans with Disabilities Act of 1990 (ADA) which were published in the Federal Register on September 15, 2010 and the United States Access Board's "Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way" though they have not yet been adopted. Below are the key requirements from the CCD Transportation Standards and Details for Curb Ramps:

- Accessible Ramp Slope = 7.8% (8.3% / 12:1 max) (Standard Drawings 7.1-7.5)
- Accessible Flare Slope = 9.5% (10.0% max) (Standard Drawings 7.1-7.5)
- Accessible Cross Slope = 1.5% (2.04% / 48:1 max) (Standard Drawing 7.0a, General Note 9)
- Accessible Running Slope = 5.0% max (Standard Drawing 7.0a, General Note 10)
- Level landing area – 5' typical length by the width of the ramp throat, 1.5% (2.0% max) (Standard Drawing 7.0a, General Note 11)
- Truncated Dome Panels (Standard Drawing 7.0b, General Note 13 and Standard Drawing 7.6b)

A field survey of the existing curb ramps was performed December 2019 by SEH. Based upon these measurements, the curb ramps on the project have been reviewed for compliance with the above requirements. The results are listed in the following table and illustrated on the exhibit in **Appendix K** identify that 31 of 33 ramps do not meet ADA guidelines. The project design will address these shortcomings by proposing to upgrade these ramps to meet City and Federal standard where possible. Though not specified, it is our understanding that Denver typically prefers directional ramps and detached sidewalks at all intersections. SEH's recommendations presented in the provided table are the most straightforward and cost-effective construction that meets ADA requirements. More extensive reconstruction may be possible at certain intersections that would create directional ramps.

ID Number	Location	Deficiency	Comments/Recommended Approach
1.	SW Corner of West 52 <sup>nd</sup> Avenue & Eaton Street	No level landing area	The slope at the top of the landing area should be less than 2%. The curb ramp could be reconstructed as a Type 2 if CCD with removal of homeowner improvements in the ROW or a Type 4 to minimize impact.
2.	SE Corner of West 52 <sup>nd</sup> Avenue & Eaton Street	No level landing area	The slope at the top of the landing area should be less than 2% and the slope to the east ramp is >8.3%. The curb ramp could be reconstructed as a Type 2 if CCD with removal of homeowner improvements in the ROW or a Type 4 to minimize impact.
3.	SW corner of West 52 <sup>nd</sup> Avenue & Benton Street	No level landing area No truncated dome panels Ramps < 5' wide	The curb ramp could be reconstructed as a Type 2 if CCD with removal of homeowner improvements in the ROW or a Type 4 to minimize impact.
4.	SE corner of West 52 <sup>nd</sup> Avenue & Benton Street	No level landing area No truncated dome panels	Due to limited ROW, a Type 4 ramp could be constructed, however this will require relocation of the storm inlet on Benton Street.
5.	NW corner of West 52 <sup>nd</sup> Avenue & Sheridan Boulevard	No level landing area Accessible flare slope > 10%	A Type 2 ramp may not fit due to limited ROW. A Type 4 ramp could be constructed.
6.	NW median of West 52 <sup>nd</sup> Avenue & Sheridan Boulevard	Accessible Ramp Slope > 8.3% No level landing area	The steep slope along Sheridan Boulevard prevents this island from complying.
7.	SW corner of West 52 <sup>nd</sup> Avenue & Sheridan Boulevard	Accessible Ramp Slope > 8.3% Accessible flare slope > 10% No level landing area	The steep slope along Sheridan Boulevard prevents these ramps from complying.
8.	NE corner of West 52 <sup>nd</sup> Avenue & Sheridan Boulevard	No level landing area	The steep slope along Sheridan Boulevard prevents these ramps from complying.
9.	SE corner of 4812 West 52 <sup>nd</sup> Avenue & Sheridan Boulevard	Accessible flare slope > 10% No level landing area	These ramps could be reconstructed as Type 2 ramps to provide a level landing at the top of each ramp, but the slope between the ramps is currently 4.3% and would increase to around 6%. The flares still exceed 10%. The ramps appear to be outside of right-of-way.
10.	NW corner of 4812 West 52 <sup>nd</sup> Avenue Apartment Driveway	No level landing area No truncated dome panels	This could be reconstructed with a Type 4 ramp, without a ramp to the north. (This apartment complex does not appear to have an accessible route from the right-of-way to the units, as required by ADA).

ID Number	Location	Deficiency	Comments/Recommended Approach
11.	NE corner of 4812 West 52 <sup>nd</sup> Avenue Apartment Driveway	No level landing area No truncated dome panels	This could be reconstructed with a Type 4 ramp, without a ramp to the north. (This apartment complex does not appear to have an accessible route from the right-of-way to the units, as required by ADA).
12.	NW corner of 4703 West 52 <sup>nd</sup> Avenue West Apartment Driveway	Accessible Ramp Slope > 8.3% Accessible flare slope > 10% No truncated dome panels	This could be reconstructed with a Type 4 ramp.
13.	NE corner of 4703 West 52 <sup>nd</sup> Avenue West Apartment Driveway	No level landing area No truncated dome panels	This could be reconstructed with a Type 4 ramp, without a ramp to the north.
14.	NW corner of 4703 West 52 <sup>nd</sup> Avenue East Apartment Driveway	No level landing area No truncated dome panels	This could be reconstructed with a Type 4 ramp, without a ramp to the north.
15.	NE corner of 4703 West 52 <sup>nd</sup> Avenue East Apartment Driveway	No level landing area No truncated dome panels	This could be reconstructed with a Type 4 ramp.
16.	SW corner of West 52 <sup>nd</sup> Avenue & Tennyson Street	No level landing area	A level landing could be created at the top of the two ramps.
17.	SE corner of West 52 <sup>nd</sup> Avenue & Tennyson Street	No level landing area	A level landing could be created at the top of the two ramps.
18.	NW corner of West 52 <sup>nd</sup> Avenue & Tennyson Street	Accessible Ramp Slope > 8.3% Accessible flare slope > 10% No level landing area No truncated dome panels	This could be reconstructed with a Type 4 ramp. A portion of the ramp may be outside the right-of-way.
19.	NE corner of West 52 <sup>nd</sup> Avenue & Tennyson Street	Accessible Ramp Slope > 8.3% Accessible flare slope > 10% No level landing area No truncated dome panels	This could be reconstructed with a Type 4 ramp.
20.	NW corner of West 52 <sup>nd</sup> Avenue & Stuart Street	No level landing area	This could be reconstructed with a Type 4 ramp.
21.	NE corner of West 52 <sup>nd</sup> Avenue & Stuart Street	No level landing area	This could be reconstructed with a Type 4 ramp.
22.	SW corner of West 52 <sup>nd</sup> Avenue & Stuart Street	No level landing area	A level landing could be created at the top of the two ramps.
23.	SE corner of West 52 <sup>nd</sup> Avenue & Stuart Street	Accessible Ramp Slope > 8.3% Accessible flare slope > 10% No level landing area No truncated dome panels	This could be reconstructed with a Type 2 ramp.

ID Number	Location	Deficiency	Comments/Recommended Approach
24.	N corner of Sheridan Boulevard & Inspiration Point Drive	No level landing area	A level landing could be created at the top of the ramps.
25.	Corner of Sheridan Boulevard, Inspiration Point Drive & 49 <sup>th</sup> Avenue	OK. This is a pass-through island. The slopes do not qualify as a ramp, so no level landing is required.	Not a ramp.
26.	S Corner of Sheridan Boulevard & 49 <sup>th</sup> Avenue	No level landing area	This could be reconstructed with a Type 2 ramp.
27.	NW corner of Sheridan Boulevard & 48 <sup>th</sup> Avenue (Sheridan Crossing)	Accessible Cross Slope >2.0%, No level landing area	This could be reconstructed with a Type 4 ramp.
28.	NW corner of Sheridan Boulevard & 48 <sup>th</sup> Avenue (48 <sup>th</sup> Crossing)	Accessible Cross Slope >2.0%, No level landing area	This could be reconstructed with a Type 4 ramp.
29.	SW corner of Sheridan Boulevard & 49 <sup>th</sup> Avenue	No level landing area	This could be reconstructed with a Type 4 ramp.
30.	W side of Sheridan Boulevard Median at I-70 Exit Ramp	OK	
31.	E side of Sheridan Boulevard Median at I-70 Exit Ramp	Accessible flare slope > 10%	The north flare could be reconstructed slightly wider or as a curb like the Type 3 ramp.
32.	NE corner of Sheridan Boulevard & I-70 Exit Ramp	OK	
33.	SE corner of Sheridan Boulevard & I-70 Exit Ramp	Accessible Cross Slope >2.0%, No level landing area	This could be reconstructed with a Type 2 ramp. This would be complicated by the traffic signal pole, traffic cabinet and bridge slope paving.

## B. Bus Stop Improvements

There are 3 RTD bus stops along Sheridan Boulevard within the project limits. They are all separated from traffic by a curb head. One has a bench and concrete pad, one only has a sign and the last stop doesn't have a sign but RTD considers it a bus stop. Additionally, RTD has requested that the City of Denver extend sidewalk north of West 52<sup>nd</sup> Avenue on the west side of Sheridan Boulevard to connect to an existing bus stop. Options include a detached sidewalk or an attached sidewalk. However, there are a variety of above ground utility infrastructure in this area. Some of these utilities might need to be relocated with either sidewalk option.

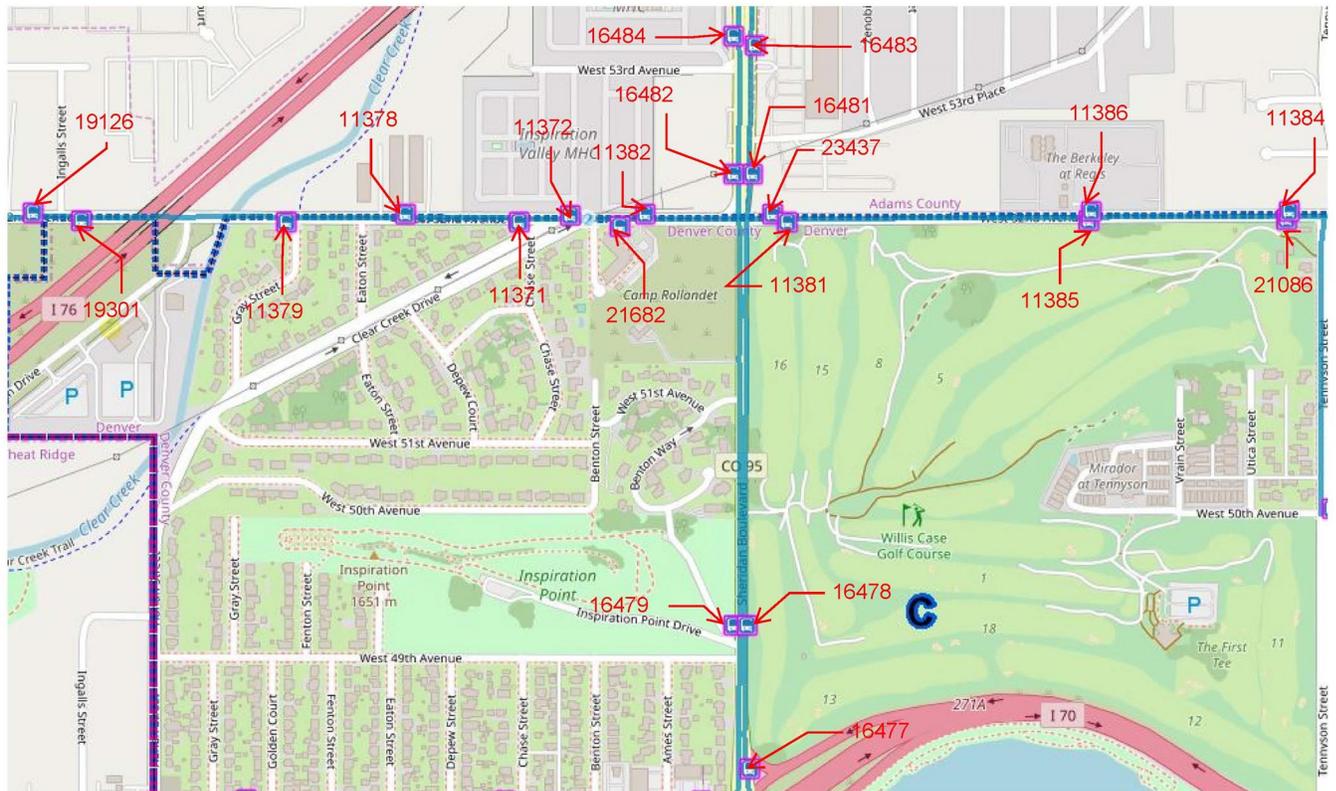


Figure 7 – RTD Bus Stops Location Map with stop numbers labeled (provided by RTD)

There are 8 RTD bus stops along West 52<sup>nd</sup> Avenue west of Sheridan Boulevard within the project area. The first stop on the south side of West 52<sup>nd</sup> Avenue west of Sheridan Boulevard is separated by curb head from traffic and has a bench set back behind the sidewalk on a concrete pad. The remainder of the existing RTD bus stops west of Sheridan Boulevard are minimally developed. They are at grade with the road with no barrier protection from traffic for users and most do not have a bench or weather shelter.

There are 6 RTD bus stops along West 52<sup>nd</sup> Avenue east of Sheridan Boulevard within the project area. The first stop on the south side of West 52<sup>nd</sup> Avenue east of Sheridan Boulevard is separated by curb head from traffic and has a bench set back behind the sidewalk on a concrete pad in a shelter. The remaining two stops on the south side of West 52<sup>nd</sup> Avenue have benches but are at grade with the road with no barrier protection from traffic for users and do not have a weather shelter. The three stops along the north side of West 52<sup>nd</sup> Avenue have curb head but do not have a bench or weather shelter. There are no bus stops on West 52<sup>nd</sup> Avenue east of Tennyson Street.

Preliminary conversations with RTD have indicated they may wish to combine some stops and improve the remaining stops. An email received February 10, 2020 from RTD (**Appendix L**) indicates they may want to combine stops 16478 and 16479 along Sheridan Boulevard.

Further discussion is needed between CCD and RTD to confirm what if any bus facility improvements are to be incorporated into this project. Once identified improvements should be designed to meet the 2010 ADA Standards for Accessible Design, specifically noting section 810 – Transportation Facilities. Bus facility design should also utilize the RTD Bus Infrastructure Standard Drawings, 2016 or more recent revisions.

RTD's 2016 Bus Infrastructure Design Guidelines and Criteria, §3.3.0.1 state, in part, that "if the bus stop is located adjacent to a street with asphalt pavement, a concrete bus pad shall be placed adjacent to the gutter pan." All bus stops in the project area meet this criterium.

§3.3.0.5 states that "Generally, shelter placement shall be evaluated at bus stops where ridership exceeds 40 passenger boardings per day, and as determined by RTD's shelter installation criteria evaluation process. The criteria include span of service, scheduling, physical space, safety and others as specified." There is only one stop which exceeds 40 boardings per day, which is the southbound stop on North Sheridan Boulevard north of West 52<sup>nd</sup> Avenue, which has 49 boardings per day. The stop with the next highest number of boardings is the stop on eastbound West 52<sup>nd</sup> Avenue east of North Sheridan Boulevard, with 35 boardings per day. This stop has an existing shelter.

RTD Bus stop design on West 52<sup>nd</sup> Avenue will utilize CCD's "constrained raised bike lane" layout, with the addition of storm inlets and laterals on the uphill side of the raised bike lane. Inlets are to be in a sump condition and pushed out of the throat of the ramp of the raised bike lane as feasible. SEH will review RTD's design guidelines and confirm the size of RTD bus pads to sit behind the sidewalk, address drainage as needed and note areas of ROW acquisition needs. Consideration of CCD's "floating bus stop with bike lane" design is not recommended for implementation because West 52<sup>nd</sup> Avenue is neither a CIC (Capital Investment Corridor) nor an FTN (Frequent Transit Network) location, because of the desire to utilize available right-of-way for water quality, and because of the need for additional right-of-way acquisition.

### **C. Right-of-way/Easement Constraints**

West of Sheridan Boulevard, West 52<sup>nd</sup> Avenue typically has a 60-foot right-of-way and east of Sheridan Boulevard the right-of-way varies from 60 to 80-feet. The existing two-lane road fits comfortably within the right-of-way in most locations. Near the Sheridan Boulevard intersection, the road widens and along the City owned Camp Rollandet Natural Area located at the southwest corner of the intersection there is only 2.5' between the existing five-foot sidewalk and the south right-of-way line. At the southeast corner of the intersection the traffic signal, curb ramps and a small part of the asphalt road fall outside the right-of-way. The south side sidewalk extending 170' east is 1.5' outside the right-of-way, though the bus stop shelter along this sidewalk is within an easement.

Along the north side of West 52<sup>nd</sup> Avenue, from 580 feet west of Benton Street to 280 feet east of Benton Street, there is an existing encroachment. The Inspiration Valley manufactured home development addressed at 5250 West 53<sup>rd</sup> Avenue backs to West 52<sup>nd</sup> Avenue and has a fence constructed 8 feet into the right-of-way, with some homes encroaching 6 feet. However, there appears to be enough space to construct potential roadway and sidewalk improvements without affecting the existing development.

Sheridan Boulevard has a varying 60 to 70-foot right-of-way width. The distance from the right-of-way to the back of curb along the east side of Sheridan Boulevard 4 to 6 feet along the north end of the project area and reduces to 1.5 to 3.5 feet south of 49<sup>th</sup> Avenue. There is 3.5' between the existing back of curb along Sheridan Boulevard and the west right-of-way line along the City owned Camp Rollandet Natural Area. It is likely that any addition of sidewalk along either side of the road or shifting of the road will require a dedication of right-of-way or a pedestrian easement. CCD Golf has indicated that project encroachment of sidewalk or other features into their property would require alignment of an equivalent offset of their golf hole layout inside their property.

Project improvements will need to be balanced against the need for additional property through right-of-way acquisition or easements. These costs should be considered and weighed against the benefits of the improvements.

The City owned Camp Rollandet Natural Area at the southwest corner of Sheridan Boulevard and West 52<sup>nd</sup> Avenue does not appear to allow for any encroachments. The Camp Rollandet Natural Area Management

Plan, dated April 2006 is included in **Appendix M**. The Deed of Conservation Easement is included in the plan and describes the limitations for use of the property. Some of the key points that may affect this project are:

- Improvements are limited to the building envelope, but:
- Repair and replacement of fences does not require any further permission (Section 4B(4)b, page 6) and
- “Any other improvements are prohibited unless the Grantee determines in its reasonable discretion that the proposed construction is not inconsistent with the preservation and protection of the Conservation Values.” (Section 4B, page 5)
- ‘Preservation of the conservation values’ is at CCD’s discretion, so it will require additional conversations and agreement on a plan.

We have as **Appendix N** an email regarding the management plan for Camp Rollandet and the points above.

#### **D. Impact on Trees**

There are some trees and vegetation that may be affected by this project. There are mature trees along the Willis Case Golf Course along the entire project frontage with Sheridan Boulevard and the first 800 feet east of Sheridan Boulevard along West 52<sup>nd</sup> Avenue. The design of proposed improvements should attempt to protect trees where possible.

The City of Denver forestry department provided a formula for the cost of tree removal and replacement for trees along the Willis Case Golf Course. It is the number of trees removed x 600 square feet / 130 (referred to as the magic number). This formula is used in the preliminary cost estimate for Sheridan Boulevard. The City of Denver golf course operations department estimated that relocating a sand trap and resetting the irrigation system to accommodate sidewalk improvements along Sheridan Boulevard will cost roughly \$75,000.

#### **E. Existing Retaining Walls**

There is a tall retaining wall along the west side of Sheridan Boulevard from Benton Way extending south 450 feet to Inspiration Park. There is a three-foot wide dirt space between the back of curb and the face of the wall that appears to be used by pedestrians on occasion. Considering the high traffic volume, narrow travel lanes and high traffic speed adding a three-foot sidewalk does not seem appropriate. For additional pedestrian comfort SEH recommends a five-foot sidewalk with an additional two-foot colored concrete strip between the curb and the sidewalk. This would require shifting traffic lanes to the east, along with shifting the east and west curb and gutter.

There is a two-tier retaining wall wrapping the southeast corner of West 52<sup>nd</sup> Avenue and Sheridan Boulevard. This wall is supporting the 16<sup>th</sup> tee box of the City owned Willis Case Golf Course. There is a five-foot wide sidewalk between the back of curb and the face of the wall along West 52<sup>nd</sup> Avenue. Considering the high traffic volume at this intersection, SEH suggests considering a detached or wider sidewalk in this area for additional pedestrian comfort, but the existing sidewalk is adequate. The wall and sidewalk only extend 10 feet south of the corner curb ramp and then continues as a ‘social’ dirt path south to I-70. If sidewalk is to be extended south, the retaining wall would need to be extended for a short distance or the grading of the berms lining the golf course would need to be modified. Additionally, CCD Golf recommends protecting pedestrians from errant golf shots by erecting chain link safety fencing along Sheridan. Consideration should also be made to add landscaping to soften the visual look of protective fencing and added protection from wayward golf balls.

#### **F. Proposed Retaining Walls**

SEH has performed a topographic survey and evaluated the vertical relationships between the existing road elevation and the surrounding ground.

The City owned Camp Rollandet Natural Area is located the southwest corner of West 52<sup>nd</sup> Avenue and Sheridan Boulevard. This area quickly falls away from both roads so that any widening or shifting of either road into the property will likely require a retaining wall to support the improvements. As discussed in the Right-of-Way/Easements section above, it may not be possible to construct any improvements on the Camp Rollandet property.

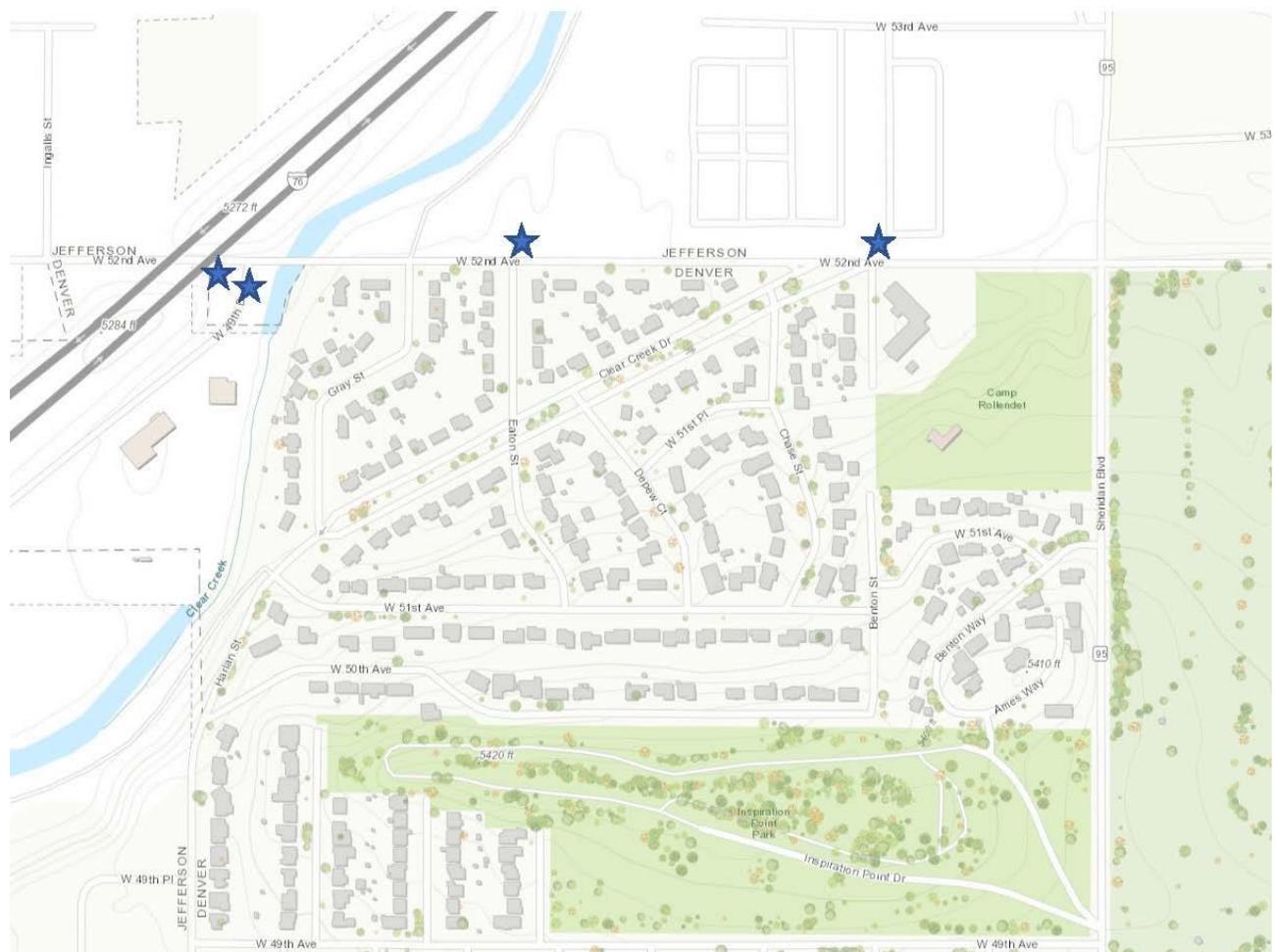
The east side of Sheridan Boulevard within the project limits is fronted by the City owned Willis Case Golf Course. There are mature trees, utility poles, overhead and buried utility lines, and landscape berms separating the 16<sup>th</sup> hole fairway from the roadway. If the roadway is shifted to the east or sidewalk is added on the east side of the existing road it is likely that short walls would be required to support the existing berms or coordination with the golf course would need to occur to reshape the berms to avoid walls.

**G. On-street Parking**

A count of the existing on-street parking was completed on West 52<sup>nd</sup> Avenue. SEH will consider locations for parking lanes while balancing the project goal of providing safe buffered bicycle lanes and develop proposed project typical sections. Residents on the south side of West 52<sup>nd</sup> Avenue are known to park along the street near Clear Creek, as well as on the south and north side of West 52<sup>nd</sup> Avenue east of Tennyson Street.

**H. Existing Conditions Drainage Complaints**

The City of Denver Wastewater Department has received drainage complaints from residents generally about large areas of standing water. Alleviating these issues will need to be a consideration in the design of this project. Below is a key map locating the problem areas and an example of a ponding issue.



★ AREAS REPORTED WITH STANDING WATER

**Figure 8 – Key map of Drainage Complaints to Denver Wastewater Department**



**Figure 9 – RTD bus stop on north side of West 52<sup>nd</sup> Avenue, between Benton Street and Sheridan Boulevard**

## **I. Drainage System Evaluation**

There are two major elements related to drainage on the West 52<sup>nd</sup> Avenue and Sheridan Boulevard project. The first is the assessment of the existing storm water collection and conveyance system and potential areas for improvement. The second major element is the hydraulic design of the West 52<sup>nd</sup> Avenue Bridge over Clear Creek. A summary of SEH’s review and findings is included below. More detailed analysis is included in the Preliminary Drainage Report in **Appendix O**

### **Hydrology**

Flows generally travel north and west in the area and all eventually end up in Clear Creek. The overall basin where the site is located within City of Denver boundary limits is called Clear Creek North of I-70 with basin ID 4300-03. The CUHP and SWMM models for this basin have been obtained from CCD and were analyzed to determine existing storm flows in the location of the project. The 2019 Storm Drainage Master Plan (SDMP) for Denver was also consulted.

### **Storm System**

The entire site lies within drainage basin 4300-03 as defined by the SDMP. The existing storm system on the project site can be divided in two main basins, the area to the west of the intersection of West 52<sup>nd</sup> Avenue and Sheridan Boulevard and the area to the east of that intersection. Storm System Maps for each of these areas have been included in **Appendix P**.

CCD Storm Sewer Master Plan pipe sizing was initially confirmed as planned in the proposal. However, after progressing the design several issues were found that impacted design:

- a. The Master Plan pipe sizing didn’t account for adequate roadway cover clearance needs over the pipe. This required alternative pipe and box culvert analysis option vetting. Due to progress made to that point on the design, revisions were also made to the utility plans for existing wet and dry utility relocations, demo plan edits and erosion control plan updates.
- b. It was also later uncovered that the Master Plan pipe sizing didn’t account for the outfall 100-year floodplain impacts on the storm system hydraulic grade design. This required additional iterative review of storm pipe sizing and layout alternatives.

- c. The Master Plan pipe sizing of the Clear Creek and West 52<sup>nd</sup> Avenue outfall was not vetted to confirm the proposed pipe size could be upsized through the existing bridge abutments. However, further analysis confirmed the maximum pipe size suitable for the existing abutments did not meet the City's conveyance needs. Additional plan edits were needed to detail and cost patching the existing bridge abutments.
- d. SEH prepared two additional layout options for alternative storm pipe outfall routing to Clear Creek. One option included two pipes sized to maximize the pipe size and avoid abutment conflicts. The second alternative included utilizing the best available information to re-route the storm pipe outfall off-site through CDOT's property to Clear Creek. It was noted that the outfall through the bridge abutment presented only moderate hydraulic gains over the existing conditions. Large storms would continue to surcharge the system and flood the street. After presenting these two options CCD requested further design layout and alternative cost option comparison for a box culvert and an open channel configuration through CDOT's property, with respective impacts to maintain access to the Clear Creek trail. The preliminary profiles of the three outfall options are in **Appendix Q**.

The area to the east of the intersection of West 52<sup>nd</sup> Avenue and Sheridan Boulevard is collected in an existing storm system and directed to a manhole junction approximately 800-feet east of the intersection. The storm system from West 52<sup>nd</sup> Avenue east of this location joins the flow from basin 4309-01 to the south of basin 4300-03. Flow from basin 4309-01 is carried in an existing 54" pipe. According to the existing SWMM model provided by CCD this pipe is flowing full during all design storms. An existing 36" pipe flowing east to west beneath West 52<sup>nd</sup> Avenue joins the flow from basin 4309-01 and is directed northwest through private property to Sheridan Boulevard in a 54" existing pipe. Approximately 100-feet downstream of this junction the pipe size increases to an existing 66" storm pipe and is conveyed to the system outfall at Clear Creek.

The SDMP recommends up-sizing this system from the intersection of West 52<sup>nd</sup> Avenue and Newton Street to the outlet point where Sheridan Boulevard crosses Clear Creek. SEH has used the existing SWMM model and updated pipe sizes to accommodate the preliminary proposed conditions to include a widened roadway pavement section to accommodate 11' lanes in either direction, buffered bike lanes and vertical curb and gutter to determine what effects the recommended upgrades within the scope of this project will have on the system.

It would be ideal to start at the outfall of Clear Creek and work upstream toward West 52<sup>nd</sup> Avenue with the recommended improvements. This would be a large undertaking and outside the current scope of this project as the outfall system lies north of our project limits. To upgrade the system in West 52<sup>nd</sup> Avenue to the SDMP recommended sizes without having a negative impact on the downstream system, proposed size increase downstream (north) of the manhole junction with basin 4309-01 would need to be upsized to the pipe sizes recommended by the SDMP. SEH recommends upgrading to the proposed sizes in the SDMP with the assumption that downstream pipes will be up sized prior to connecting the improved system along West 52<sup>nd</sup> Avenue.

It is possible that with the improvements proposed by the SDMP downstream of the site and additional improvements upstream of the project that the proposed pipe recommended for West 52<sup>nd</sup> Avenue east of the junction with 4309-01 could be reduced in size. The proposed pipe sizes in the SDMP are oversized for the capacity that they are required to carry. However, the junction with 4309-01 creates a backup since the pipe entering from the south is flowing full in all storm event conditions. Referencing the SDMP basin study for basin 4309-01, there are two pipes, a 78" and a 72", that flow to a manhole with the outlet pipe being the 54" that flows through the golf course and connects to the storm system in 4300-03. This upstream bottleneck is likely the reason that this pipe is flowing at capacity in all three rain events included in the SWMM model (2-year, 5-year, and 100-year.) The upstream system was not analyzed as a part of this project and would require an additional study to determine solutions to the full flowing 54" pipe that flows through the golf course to West 52<sup>nd</sup> Avenue.

Additional study of basin 4309-01 would be necessary to determine any recommended pipe size reductions in West 52<sup>nd</sup> Avenue. Without further study outside the scope of this project, SEH will relocate and size inlets in coordination with the proposed street improvements. Existing pipes will be utilized unless elevations do not work with new inlets.

## Bridge Hydraulics

There are currently three hydraulic models in the area of the West 52<sup>nd</sup> Avenue bridge over Clear Creek and the FEMA website has conflicting information on the 100-year flood elevation. The bridge straddles two floodplain panels with different effective dates that reference different models. There is a 1979 HEC-2 model that is considered the effective model to the south of the bridge and a 2007 HEC-RAS model that appears to be the effective model to the north of the bridge. Mile High Flood District (MHFD) is currently in the process of completing a Flood Hazard Area Delineation (FHAD) study on the area. In conversations with the City of Denver it was recommended that this be the model used in assessment of any improvements to the bridge.

The model for the MHFD FHAD was provided to SEH and used to complete a proposed conditions model to determine the elevation necessary for any proposed bridge to meet the 3-feet of freeboard above the 100-year storm set out by Denver criteria. Pending the results of more detailed study of the hydraulics in the area, this would require a minimum of a 3.5-foot raise of the bridge elevation. This raises multiple concerns including the proximity to the I-76 bridge, tie into adjacent roads, and the fact that no reference material showed any easements for Clear Creek. The property lines in this area go to the center of the creek. The potential replacement of the bridge is discussed further in the section of this report titled Clear Creek Bridge Structural Evaluation, Bridge Replacement.

There is an existing drop structure about 40-feet downstream of the bridge. It is an approximately 2' drop followed by a section of slightly steeper creek for 100 feet. The average stream slope in the area is 1% and this section is 2%. It is possible that with additional channel work the existing drop structure could be moved upstream of the bridge to lower the 100-year storm elevation under the bridge and minimize the rise necessary to meet the freeboard requirement. The 2% section of creek could also be flattened to lower the elevation below the bridge. Determining the exact impact of these modifications would require additional hydraulic information and a more detailed study of the area. If lowering the channel is pursued, additional structural analysis would be required. The initial review of this option suggests the bridge abutments and piers would need reinforcing and concrete extended downward.

In the area adjacent to the bridge, the creek is not within a dedicated right-of-way. The area north of the bridge and the southwest parcel to the center of the creek is owned by CDOT. The southeast lot at 5930 West 52<sup>nd</sup> Avenue is a private residence. We understand the City has the right to work in the creek through US Army Corps of Engineers but there is no access route to the creek. Creek modifications would likely require an agreement with property owners to obtain easements along Clear Creek north and south of the bridge to make these improvements.

It is anticipated that any work on this bridge beyond superstructure repair will likely require a LOMR at minimum and potentially a CLOMR.

### J. Detention and Water Quality

There are a few potential places to install water quality and detention improvements. The easiest to fit within the project footprint would be underground water quality facilities. Stormceptors could be added to inlets to reduce particulates in the downstream system. Underground water quality and detention basins could be added below the right-of-way along West 52<sup>nd</sup> Avenue to improve water quality and reduce the discharge rate to the downstream system. The drawback to underground solutions is the maintenance required to keep them working properly.

Willis Case Golf Course initially suggested that an agreement could be made to add a water quality and detention pond on their property that would service the project area. This solution would be ideal as it could be placed at a low point for the eastern portion of the project site and depending on the available land could have potential to mitigate the flow coming in from basin 4309-01. Disconnecting some of the impervious area from West 52<sup>nd</sup> Avenue could also benefit water quality. This would be best achieved using roadside bioswales. The area adjacent to Willis Case Golf Course best lends itself to this option. CCD subsequently decided the 30% submittal should not affect the golf course along West 52<sup>nd</sup> Avenue. Any golf course use will need to be explored further with future design development.

The City has provided the map below in Figure 10 to indicate opportunities for water quality improvements. The best opportunities appear to be along West 52<sup>nd</sup> Avenue in conjunction with the bike lane and near the bus stop(s) to help eliminate flooding.



Build curb and gutter here, where absent, and include GI behind the curb

Swale-like green infrastructure between gutter pan and golf course



**Figure 10 – Water Quality Opportunities**

The design team has reviewed CCD’s suggestions and included water quality concepts in the 30% design plans. These include two porous landscape detention areas along West 52<sup>nd</sup> Avenue in the median of Clear Creek Drive and in an open area just west of Clear Creek Drive. This also includes a narrow swale in the West 52<sup>nd</sup> Avenue right-of-way along the Willis Case Golf Course frontage. A more detailed memo is included in **Appendix R**.

**K. Ultra-urban Green Infrastructure Opportunities**

Ultra-urban Green Infrastructure can potentially be applied to the project to align with Denver’s strategy to incorporate site-level green infrastructure to help the overall basins more closely mimic natural systems. Denver’s Ultra-Urban Green Infrastructure Guidelines were consulted to determine potential solutions. The best areas for the use of these types of BMPs are along West 52<sup>nd</sup> Avenue adjacent to the Golf Course and the area of Sheridan Boulevard included in the project south of West 52<sup>nd</sup> Avenue. Green gutters or street side storm water planters could be used in these areas to help minimize the effect of runoff from the road on water quality and reduce flow rates to the downstream storm system.

## L. Environmental Evaluation

ERO Resources Corporation (ERO), on behalf of SEH, conducted an Environmental Records Review (ERR) for the Pedestrian Safety Improvement Project at Sheridan Boulevard and West 52<sup>nd</sup> Avenue. This ERR consists of a review of historical information and federal, state, and local records and preparation of this report. The purpose of this assessment is to identify potential environmental concerns within the improvement area. A summary of the findings are presented below with the full report attached in **Appendix S**.

### Environmental Conclusions

Federal, state, and local records identified numerous regulated sites near the project area. The following sites represent environmental concerns with respect to the project:

- The former Sheridan Dump is located adjoining West 52<sup>nd</sup> Avenue and Sheridan Boulevard to the northeast. Historical research and sampling were conducted by the U.S. Environmental Protection Agency (EPA) that identified historical solid and potentially hazardous waste was disposed in the landfill. EPA sampling in 1995 identified elevated contaminants of concern within the landfill area property but did not delineate the extent or take any soil, groundwater, or vapor samples near the project area on West 52<sup>nd</sup> Avenue. In addition, the landfill is identified by the Tri-County Health Department as a methane-producing landfill and is within the Adams County Flammable Gas Overlay, subject to specific land development regulations. Based on these findings, potentially contaminated soil, groundwater, and soil vapor may be encountered on or near the landfill as well as the potential for hazardous atmospheres to occur within subsurface work areas.
- Two additional historical landfills are located at the intersection of West 52<sup>nd</sup> Avenue and Interstate 76. The landfill known as “West 52<sup>nd</sup> Avenue and west of Sheridan” is located north of the intersection of West 52<sup>nd</sup> Avenue and Gray Street, along Clear Creek. The second landfill, known as “West 52<sup>nd</sup> Avenue west of Clear Creek,” is located west of Interstate 76, north of West 52<sup>nd</sup> Avenue. Records reviewed indicate methane concentrations up to 63 percent methane in soil vapor at these landfills, well above the lower explosive limit for methane. Based on these findings, potentially contaminated soil, groundwater, and soil vapor may be encountered on or near the landfills, as well as the potential for hazardous atmospheres to occur within subsurface work areas.
- The Willis Case Golf Course is located at 4999 Vrain Street, adjoining West 52<sup>nd</sup> Avenue to the south, between Sheridan Boulevard and Tennyson Street. The site was identified as a hazardous waste generator with halogenated solvent use since 1997. Because the operations area for the golf course is the likely location of historical use and is immediately adjacent to the project area, the site represents a potential environmental concern. The historical runoff from the facility operations area may have impacted the soils in the project area.
- The Berkeley Garage, located at 6000 West 52<sup>nd</sup> Avenue, was identified as a former leaking underground storage tank (LUST) site with reported spills. The facility continues to operate a 10,000-gallon UST on the site. Based on the uses of the facility as a garage with a UST currently in use, and the former fuel leaks and spills at the site, residual groundwater impacts associated with the site may be encountered in the project area.

### Environmental Recommendations

The proposed sidewalk improvements may include curb and gutter, roadway pavement, utility adjustments, and upgrades or replacement of the West 52<sup>nd</sup> Avenue bridge over Clear Creek. As such, ERO recommends the following:

- Environmental oversight during construction activities for potential hazardous vapors related to landfill gas and/or petroleum storage tanks, and the potential for asbestos-containing materials (ACM) from former landfilling activities;
- Awareness training for employees concerning hazardous conditions that may be encountered during construction activities;

- Development of a Materials Management Plan for the identification, management, and disposal of non-native materials that may be encountered during construction activities; and
- Oversight during potential bridge work, as groundwater and contaminated soils may be encountered during caisson drilling. Any contaminated media encountered during caisson drilling would need to be treated and/or disposed.
- During excavation or any soil disturbing activity, Colorado regulations require all exposed construction and demolition debris (including ash) be assessed for asbestos contamination. It is the contractor's/sub-contractor's responsibility for providing the onsite personnel (certified asbestos building inspector) capable of this requirement. Any amount of debris found to be contaminated with asbestos may be classified as regulated asbestos contaminated soil (RACS) and must be managed, documented, and disposed of in accordance with the City and County of Denver's RACS standard operating procedure (see link below) and the Colorado solid waste regulations (6 CCR 1007- 2, part 1). Onsite management of RACS requires immediate notification of trained field personnel at the state health department, and implementation of measures to prevent cross contamination to the public. For additional information, please call the Denver Department of Public Health & the Environment (DDPHE) at 720-865-5452.

## M. Clear Creek Bridge Structural Evaluation

This structural evaluation is an assessment of the current bridge carrying West 52<sup>nd</sup> Avenue over Clear Creek (Structure No. D-09-CLC-010) near the border of Jefferson County and the City and County of Denver. The bridge is located within the limits of the Sheridan Boulevard and West 52<sup>nd</sup> Avenue Pedestrian Improvements Project being designed by SEH on behalf of the City and County of Denver. The assessment is intended to support the determination of whether the bridge will be rehabilitated or replaced as part of the project.

### Existing Bridge Information

To perform this assessment information about the bridge was collected from the following sources:

1. Most Recent Bridge Inspection Report, 01/22/2019.
2. Original bridge plans, provided by CDOT, dated 1968.
3. Topographic and hydraulic cross section survey, by SEH December 2019.
4. Site visit observation by SEH bridge engineer, 01/29/2020.

### Existing bridge summary

According to the information collected, the bridge was built in 1969 and has two equal spans making a total structure length of 114 feet. The bridge superstructure consists of rectangular, reinforced cast-in-place concrete girders with an integral reinforced concrete deck. The deck has a crown at the center and transverse slope down to concrete curbs. The bridge rail is a curb-mounted steel tube and post system. The substructure consists of reinforced concrete wall abutments and a pier which are supported on vertically driven steel piles founded in the claystone bedrock layer. The bridge appears to be fixed at both abutments and the pier.

Per the inspection report, the average daily traffic (ADT) is 7,662 taken in 2016 with a 6% truck ADT, the future ADT is 9,424 (anticipated in 2036). More accurate traffic counts should be requested from CCD, or other applicable agency, to see if they are available and how they compare to the inspection report counts.

### Structural Assessment

**Condition:** The inspection report condition ratings (out of a possible 10) for the deck, superstructure, substructure, and channel are 5, 5, 6, and 6 respectively. This represents an average general condition for the structure. Cracking, efflorescence, and rust staining has been observed in several locations on the underside of the bridge deck. Hairline cracking, honeycomb spalling, and exposed reinforcing has been observed at the bottom of several girders. Light cracking, efflorescence, and spalling has been observed at portions of the existing pier and abutments. Field observations confirm the condition assessment of the bridge inspection. The

efflorescence observed is more considerable for the bridge deck compared with the girders, and ranges in severity with over half of the observable bridge deck area appearing to have significant efflorescence.

The defects are not significant enough to reduce structural capacity, but they are indicative of the long-term deterioration that is typical with vehicular bridges. Rehabilitation techniques can be used to protect the remaining structure and slow future deterioration, but they have limited ability to reverse the deterioration that has already occurred. The deterioration that has occurred will reduce the design life of the rehabilitated structure and this reduced design life should be considered when comparing rehabilitation vs. replacement.



**Figure 11 - Bridge Deck overhang efflorescence**

**Figure 12 - Typical interior bridge deck efflorescence**

Also observed during the inspection was evidence of active scour including a scour hole and displaced rip rap. The bridge is on deep foundations so stability is not a concern, but designed scour countermeasures should be considered for rehabilitation design. Observations during the 2020 site visit of the amassed debris and displaced rip rap confirm the observations recorded in the most recent inspection report.



**Figure 13 - Debris collection at upstream side of pier and displaced rip rap**

**Capacity:** The bridge is currently not load posted based on a Load Rating performed in 1996. The load rating summary page was reviewed, but back up calculations for the analysis were not available. We performed a conceptual level load rating analysis of the existing structure and the deck replacement option. At this stage of design, our analysis was not able to confirm the capacity of the existing structure and determined that the deck replacement option may not provide an adequate load rating factor with current design vehicles and load rating analysis method. *Further analysis may be able to confirm that the deck replacement option is viable, but based on our analysis to this point, the deck replacement option is not considered structurally feasible.*

### Safety/Geometry

**Bridge Width:** The out-to-out bridge width is 53', which includes two curbs (1'-3" wide each) a 4'-6" sidewalk on the south side of the bridge and a roadway width of 46'. The bridge is currently striped for two lanes, one in each direction. The proposed design may add sidewalks to the north side of the bridge and/or increase the sidewalk width on the south side of the bridge. If the roadway width is being reduced in the rehabilitated condition, the width should be checked for adequacy based on future ADT.

**Railing:** On the sidewalk side of the bridge, the railing has a height of 2' above the top of sidewalk. On the north side of the bridge, the railing has a height of 1'-3" above the top of curb. The curb heights are 12"-13" high from top of curb to top of top of deck and there is a 2" thick asphalt wearing surface. The current bridge rail does not meet CDOT geometry requirements and its capacity to sustain vehicular impact loads is unknown. A replacement railing system should meet current geometry requirements for vehicles, pedestrians, and cyclists. The bridge rail should also meet CDOT structural requirements or be designed to resist the appropriate vehicular impact loads based on the road's classification and design speed.

**Approach railings:** There are no approach railings on the south side of the bridge. On the north side of the bridge there is no approach rail on the west side, although there is a chain link fence that starts at the end of the bridge rail and runs parallel to the West 52<sup>nd</sup> Avenue to the west until it hits the I-76 Eastbound bridge over West 52<sup>nd</sup> Avenue. There is a short approach guardrail attached to the end of the northeast corner of the bridge rail that transitions into the ground and has a chain link fence behind it. The proposed design should provide approach railing in accordance with current CDOT standards, as the site geometry allows.

**Approach roadway:** The horizontal alignment at both bridge approaches is straight. The vertical alignment is relatively flat without a noticeable vertical curve or longitudinal slope. The I-76 Bridge over West 52<sup>nd</sup> Avenue is about 200 feet from the west end of the bridge. The intersection of West 49<sup>th</sup> Drive is less than 150 feet from the west end of the bridge. There is an access into the fenced-in property at the northwest corner of the bridge less than 50 feet from the west end of the bridge. There is a driveway for the private property at the southeast corner of the bridge located less than 50 feet from the end of the bridge. Because of the proximity of all of these access ways, the ability to alter the bridge profile is limited, without significant impacts and associated costs to adjacent properties and structures.

### Environmental

**Clear Creek:** Clear Creek is likely considered a Waters of the US (WOTUS), and as such construction work within the channel will likely require an Army Corps permit. The type of permit will be dependent on the scope of the construction work. Typically, the more invasive and impactful the work is to the channel, the greater the effort/cost is to obtain the permit. An environmental permitting specialist should be consulted to determine the appropriate permit for the scope of work proposed.

A grade control structure was observed less than 50' downstream of the bridge. The proximity of this structure to the bridge may limit the extents of channel alterations under/through the bridge. If more significant channel alterations are proposed, the grade control structure may need to be removed or relocated.

**Water Quality:** The current bridge curbs and sidewalk have horizontal openings which we believe were intended to allow surface water runoff from the bridge deck to directly enter Clear Creek. This is no longer standard design practice. This configuration allows surface water to come in contact with the exterior faces of the bridge deck and girders and can increase the rate of structural deterioration for the elements that are exposed to surface water because of freeze/thaw cycles and presence of de-icing chemicals. This configuration also allows untreated surface water to directly enter the creek.



**Figure 14 – Existing Bridge Curb Openings**

**Birds:** Bird’s nests were observed under the structure. These nests should be evaluated by a qualified person. Removal of nests prior to construction, or construction during seasonal periods when birds aren’t active may be necessary.

## Utilities

**Wet Utilities:** There do not appear to be any wet utilities carried across the bridge. There are two pipe penetrations through the east abutment that outlet into the creek and appear to be drainage/water related. The penetrations do not appear on the existing bridge plans. The FIR level proposed design will re-route this utility and the existing penetrations will be infilled with reinforced concrete.



**Figure 15 - East abutment pipe penetrations**

**Dry Utilities:** There is an overhead utility parallel and to the north of the bridge. And there is a series of conduits hung under the overhang on the northern side of the bridge. Further consideration and coordination for both utilities will be required during future design stages to address potential temporary and permanent impacts.



**Figure 16 - Overhead and bridge supported dry utilities**

## Bridge Rehabilitation Alternatives

Improvements that should be considered if the rehabilitation option is selected for the bridge can be grouped into the following categories: Structural Condition/Capacity, Safety/Access, Water Quality, Hydraulic/Scour.

**Structural Condition/Capacity:** Based on the poor condition of the deck, we do not recommend that it be reused or salvaged. Therefore, there are two bridge rehabilitation options that can be considered, deck replacement or deck and girder (full superstructure) replacement (see Bridge Options 1 and 2, **Appendix T**). The deck only replacement includes careful removal/replacement of the entire width of the existing deck allowing for reuse of the existing girders. This option presents more challenging construction as the existing girders have to be protected and may have to be shored from the creek channel to accommodate the weight of the new deck until it has cured. This option also has a question associated with the condition of the existing girders that would remain. Although it appears they are in good condition there is likely some deterioration at the interface between existing deck and girders, but the limits and extents of this deterioration is unknown. The existing girders also have a limited load carrying capacity, so this proposed rehabilitation configuration may be limited. After performing a preliminary load rating, we do not believe the deck replacement provides a structurally adequate final configuration, so this option is not recommended. Further structural analysis may be able to confirm the feasibility of this option.

The total superstructure replacement would remove both the deck and girders and replace with new structurally adequate, prestressed concrete girders supported by the existing abutments/pier (see Bridge Option 2, **Appendix T**). This option is easier to construct, and eliminates the question about the existing girder condition, but does increase construction cost for the new girders. The new girders also will not have the same limitations as far as load capacity as the existing girders do in the deck only rehabilitation option.

Concrete crack and spall repair, including removal of deteriorated concrete and cleaning exposed rebar, is recommended for abutments and piers.

For either rehabilitation option, a solid curb is recommended to reduce the rate of bridge deck overhang deterioration due to exposure to surface water runoff and de-icing chemicals.

**Safety/Access:** Safety improvements that are recommended for the rehabilitation option include wider sidewalks, which it appears can be accommodated without widening the out-to-out width of the structure. Rail heights that meet current minimum standards are also recommended. The structural capacity of the railing system should be updated to current standards by using standard CDOT rail details or by using a railing system structurally designed for appropriate vehicle impact loads.

Further consideration is required to determine if incorporation of a multi-use trail below the bridge is feasible. Typically, the trail profile would be designed to be above a determined flow event frequency (typically between 2-year and 10-year) while also providing adequate vertical clearance (9' minimum) to the low chord of the bridge. There are currently multiple existing hydraulic models with different water surface elevations at the bridge. Based on current design, incorporation of a trail under the bridge is not feasible for rehabilitation options.

**Water Quality:** Options for the bridge rehabilitation include keeping the horizontal curb openings or using a solid curb and accommodating deck surface water at the outside corners of the bridge. Either of these options can relatively easily be incorporated into the bridge rehabilitation design. The determination of which option is incorporated should consider the project's goals for water quality, permitting requirements, and the long-term durability of the bridge.

**Hydraulic/Scour:** The bridge rehabilitation option has limited ability to increase the hydraulic opening and/or increase the bridge freeboard. The existing bridge's low chord elevation and span length cannot feasibly be changed for the deck replacement option and can only be minimally improved for the superstructure replacement option. So, the only way to increase hydraulic capacity significantly is to lower the channel elevation through the bridge. This would require significant channel work, reconfiguration of adjacent grade control structures, and lowering the bottom of abutment and piers, and therefore isn't considered feasible or worth the significant cost to construct.

Scour countermeasures can relatively easily be incorporated into the rehabilitation design and are recommended. A scour analysis would be performed based on the design flows and channel geometry and scour countermeasures would be designed and installed around the bridge foundations. Current scour countermeasure design includes rip rap and lowering of the pier concrete to protect the existing steel piles.

### Bridge Replacement

The bridge replacement alternative provides more ability to meet current design standards and provides for a greater structure design life, but with these opportunities comes a higher cost for both design services and construction. (see Bridge Options, **Appendix T**) The bridge profile could be raised to allow the required three-feet of freeboard above the 100-year storm water surface elevation to meet the hydraulic regulations.

A concept level roadway profile over the bridge is included in **Appendix U**. The profile is designed based on the posted speed of 30 MPH and a design speed of 35 MPH. At this design speed the AASHTO green book requires minimum K values for curves of 29 and minimum 50-foot length curves. The profile is raised to accommodate three-feet of freeboard above the 100-year storm water surface elevation. The profile shows that the profile will be higher than existing at the intersections of West 52<sup>nd</sup> Avenue with West 49<sup>th</sup> Drive and Gray Street so that some small adjustments will need to be made to the side streets. The driveways at 5930 and 5910 West 52<sup>nd</sup> Avenue will also be affected by this profile. At 5930 West 52<sup>nd</sup> Avenue the centerline profile is raised 3.6' and the garage appears to be roughly level with and less than 40 feet from the roadway. Construction of the raised road may preclude access to this lot. At 5910 West 52<sup>nd</sup> Avenue the centerline profile is raised 2.2' and the garage appears to be raised a few feet above the existing roadway. This may allow for regrading of the driveway and front yard to drain and maintain access. Additional survey from the road to the front of the buildings is required to make an accurate assessment of the profile impacts on these properties.

Raising the bridge elevation will likely require additional utility work. There are several dry utilities hung from the bridge. Raising the bridge would require raising these utilities as they approach the bridge from both sides.

The replacement bridge geometry can be specified to accommodate the desired sidewalk widths on either side of the bridge, or pedestrian/vehicle separation can be provided. A new solid curb mounted CDOT standard rail is recommended with standard approach railing geometry.

The hydraulic opening for the replacement bridge can be designed to current standard, which may require an increase in hydraulic opening and/or raising of the low chord elevation, compared to the existing structure. The replacement bridge design can also more easily accommodate a trail under the bridge, which may require more significant alterations to the channel/bridge geometry so that adequate vertical clearance can be achieved while keeping the trail profile above the water surface elevation of the design flow event.

### Rehabilitation vs. Replacement Assessment

As a result of this assessment the deck replacement option is not considered structurally feasible without a more significant investigation and structural analysis of the proposed configuration. Feasible options are the superstructure replacement and the full bridge replacement options. The ultimate decision whether to rehabilitate or replace the structure should consider the project's goals, future expansion plans, design and construction costs, and the future design/service life of the alternatives. Preliminary design alternative sketches are provided in **Appendix T**.

**Structural Cost Comparison:** Using both rehabilitation options and a bridge replacement option to current design standards, cost estimates for each alternative are provided in **Appendix T**. The bridge replacement option only includes structural cost and not additional costs to potentially raise the profile, which might include import of fill material, additional adjustment of adjacent intersections and driveways and potentially purchasing adjacent property. A cost summary is provided below:

Bridge Treatment Option	Preliminary Construction Cost (2020)
Option 1 – Deck Replacement	\$776,000
Option 2 – Deck and Girder Replacement	\$1,537,000
Bridge Replacement	\$2,513,000

**Design/Service Life:** If the replacement bridge is designed in accordance with the current CDOT bridge design manual, a design life of 75 years is anticipated. For the rehabilitation option, a design life in the range of 20 to 30 years is anticipated. The service life of the bridge alternatives may be less than, equal to, or greater than the design life depending on how well bridge maintenance is performed, assuming regular routine inspections are performed and identified issues are proactively addressed.

#### N. Utility Impacts

There is a full range of existing wet and dry utilities within the project limits. Potential improvements may widen, shift and/or lower roadways. These changes may require relocation of utility poles and junction boxes within the corridor. Drawings of existing utilities are included in **Appendix V**. The list of known utilities and their contact information is below:

#### UTILITY CONTACT LIST

UTILITY COMPANY	NAME	TELEPHONE	EMAIL
DENVER WASTEWATER - STORM	LISA CHERRY	303-446-3422	LISA.CHERRY@DENVERGOV.ORG
DENVER WASTEWATER - SANITARY	JENNIFER WILLIAMS	303-446-3549	JENNIFER.WILLIAMS@DENVERGOV.ORG
DENVER TRAFFIC	DOMINICK TUFANO	720-865-4063	DOMINICK.TUFANO@DENVERGOV.ORG
METRO WASTEWATER	DAVID OWENS	303-286-3397	DOWNENS@MWRD.DST.CO.US
ARVADA WASTEWATER	SARGENT MCDONALD	720-898-7769	SAMCDONALD@ARVADA.ORG
ARVADA STORM	SARGENT MCDONALD	720-898-7769	SAMCDONALD@ARVADA.ORG
ARVADA WATER	SARGENT MCDONALD	720-898-7769	SAMCDONALD@ARVADA.ORG
DENVER WATER	RAY BATTS	303-628-6682	RAPHEAL.BATTS@DENVERWATER.ORG
CDOT TRAFFIC	TANISHA ALFORD	303-512-5979	TANISHA.ALFORD@STATE.CO.US
COMCAST	AARON RUDD	720-708-8902	AARON_RUDD@COMCAST.COM
CENTURYLINK	JUSTIN METZLER	303-525-7086	JMETZLER@TERRATECHLLC.NET
ZAYO	STEVE WARD	720-682-7698	STEVEN.WARD@ZAYO.COM
XCEL GAS	BRANDY SLOAN	720-354-2000	BRANDA.L.SLOAN@XCELENERGY.COM
XCEL ELECTRIC	BRANDY SLOAN	720-354-2000	<a href="mailto:BRANDA.L.SLOAN@XCELENERGY.COM">BRANDA.L.SLOAN@XCELENERGY.COM</a>
JEFFCO ROAD & BRIDGE	DOMINGO LORA	303-886-7539	DLORA@JEFFCO.US

There are utility poles along the east side of Sheridan Boulevard from I-70 north past West 52<sup>nd</sup> Avenue. They are two to six feet behind the existing curb. If the street is shifted east or a sidewalk is added to the east side these poles will need to be relocated or constructed around.

If the City decides to add curb and gutter to West 52<sup>nd</sup> Avenue west of Sheridan Boulevard, the road may need to be lowered six inches or more to allow adjacent properties to continue to drain to the roadway and the gutter

to flow to low point inlets. The cover over existing utilities under the pavement would need to be confirmed. Waterline is typically laid with a required deep for frost protection and the utility owner may need to lower the waterline to maintain this cover.

The City may choose to replace the existing West 52<sup>nd</sup> Avenue bridge over the Clear Creek due to limited hydraulic capacity or limited lifespan. If the bridge is replaced, the dry utilities which hang from the bridge will need to be temporarily supported and reattached. If the City chooses to raise the road with bridge reconstruction, the utilities may want to relocate to avoid becoming unnecessarily deep.

Centurylink has indicated that they own duct banks on the north side of West 52<sup>nd</sup> Avenue and east side of Sheridan Boulevard. These banks are composed of a group of 3.5" asbestos fiber ducts with a 6" concrete cap. If design of this project disturbs these lines, special care should be taken. This may include having a Certified Asbestos Building Inspector (CABI) onsite during excavations and special bagging and disposal procedures.

#### **O. Geotechnical Investigation**

SEH, through Shannon Wilson as a subconsultant, conducted a preliminary geotechnical investigation for high-risk areas and to validate project alternatives and design. The work is based on field visual inspection and existing data. More complete testing is anticipated during future final design. If the City chooses to replace the existing West 52<sup>nd</sup> Avenue bridge over Clear Creek, additional investigation would be needed to design bridge abutments. See the letter titled Preliminary Evaluation of Geologic and Geotechnical Conditions in **Appendix W**.

#### **P. Golf Course Impacts**

The City-owned Willis Case Golf Course is adjacent to the project area along the east side of Sheridan Boulevard for about 2,300 feet and the south side of West 52<sup>nd</sup> Avenue for about 2,500 feet. Along Sheridan Boulevard, there are trees, utility poles and berms separating the 14<sup>th</sup> and 16<sup>th</sup> hole fairways from the roadway. If the roadway is shifted to the east or sidewalk is added on the east side of the existing road it is likely that short walls would be required to support the existing berms or coordination with the golf course would need to occur to reshape the berms to avoid walls.

If a sidewalk is constructed along the east side of Sheridan Boulevard or the south side of West 52<sup>nd</sup> Avenue, the golf course may want to add fencing to protect pedestrians from errant golf balls. The City golf course representatives provided a detail of the 12-foot-tall chain link fence that they may require for pedestrian protection **Appendix X**.

If a chain link fence is installed, the City should consider including regular breaks in the fence to support pedestrian safety and hazard escape. As proposed by golf course representatives, this is a long stretch of fence, and in case of either an oncoming vehicle where a driver has lost control, or other hazard, a pedestrian would have limited escape options if there are no breaks in the fence. (While the current condition does not include a sidewalk, the entire course is open as a refuge as it is currently unfenced.)

If the pedestrian improvements have a significant impact on the golf course, the cone of influence of each hole will need to be evaluated. This is the most likely landing area for a golfer's first and second shots. If improvements affect the cone of influence, the golf course may need to be redesigned.

The City golf course representatives indicated they may accept utilizing the north edge of the golf course for water quality improvements if they do not affect the play of the course. Maintenance of any improvements for the roadway would need to be included in the roadway maintenance budget. Please see Section S below for further discussion of typical section design and impacts on the golf course.

#### **Q. Stakeholder and Adjacent Project Coordination**

Part of the initial reason for the project is a letter from Ken Salazar letter requesting sidewalks on Sheridan Blvd and multi-jurisdictional coordination on West 52<sup>nd</sup> Avenue. In addition, the Inspiration Point Homeowners Association (HOA) has stated a desire to improve the entrance to Inspiration Point Park perhaps with this or a future project. The HOA has also requested that the City address pedestrian and bicycle safety and residential

connectivity linking the Berkeley Park bike trail to the Clear Creek bike trail through the neighborhood, as well as a link the sidewalk and trail extension. The letter from Ken Salazar and email correspondence from the HOA is included in **Appendix Y**.

There are multiple potential projects adjacent to this project which will be considered during design. CDOT is planning interchange improvements at Interstate 70 and Sheridan Boulevard. Some of these proposals may impact CDOT's I-70 off Ramp and 48<sup>th</sup> Avenue intersection improvements with this project. The City of Arvada has performed a study of the Clear Creek Trail.

The City of Denver Parks and Recreation Department studied reconfiguring the entrance to Inspiration Point Park for better pedestrian and traffic safety in 2012. The current access is roughly 20 feet north of West 49th Avenue. The City evaluated moving the entrance to the intersection of West 49th Avenue and North Ames Street. Their preliminary cost estimate was \$850,000. The preliminary layout and cost estimate are included in **Appendix Z**. SEH reviewed the layout and cost estimate. SEH added items for tree removal and replacing the existing driveway with an attached sidewalk. The remainder of the items and quantities seem appropriate for this level of design. We also updated the unit costs based upon the CDOT 2020 Cost Data book. SEH's project cost update is included in **Appendix AA**.

Tony Brindisi of CDOT provided comments on the 30% design via the stakeholder meeting process on February 16, 2021. The excerpt follows and the email itself is included in **Appendix BB**:

"Now that I am seeing this plan set for the first time, I will quickly say that lane widths are substandard in this segment already and CDOT R1 Traffic would like the project to seek a solution that allows for increasing of lane widths to a minimum of 10.5' uniformly and at least a 9' turn lane width. This corridor is already narrow enough and alternatives need to be considered, up to and including narrowing the proposed multiuse path, narrowing of the area to the direct East of the path, shifting of the path, retaining wall, and fence to the East to a point that would allow the construction of a wider path as Denver prefers. Willis Case Golf Course is Denver Parks property, so DOTI is encouraged to work with Denver Parks to obtain said land needed to facilitate a path as Denver has described on this 30% set. CDOT R1 Traffic agrees that a sidewalk from the WB I-70 off ramp at 48<sup>th</sup> up North to the next signalized intersection (West 52<sup>nd</sup> Avenue) is a positive improvement that we support in terms of addressing pedestrian safety, ADA accommodations, and a designated bike route. However, we need to find a solution that works for all modes of transportation navigating this segment of Sheridan."

SEH notes that the recommended project scope is to only construct the attached sidewalk to the back of the existing curb on the east side of North Sheridan Boulevard to minimize additional ROW needs from Willis Case Golf Course due to the potential for significant cost related to realignment of the adjacent golf holes. However, final plans will note the potential to reconsider CDOT's preference for a wider road section between West 52<sup>nd</sup> Avenue and Sheridan Boulevard and West 48<sup>th</sup> Avenue and Sheridan Boulevard with future final design, and the cost estimate will provide an additional conceptual level cost to make that change (assuming CCD will approve a variance to their arterial section for the indicated lanes widths during final design).

#### **R. Cost Sharing and Maintenance Agreements**

Jefferson County owns portions of the West 52<sup>nd</sup> Avenue right-of-way on the north side of the street west of North Sheridan Boulevard. It also owns both sides of the street just west of Ingalls Street, as well as both sides of the street between I-76 and Clear Creek. It also owns the pavement, striping, and signage in these areas.

Similarly, Adams Co owns portions of the West 52<sup>nd</sup> Avenue right-of-way on the north side of the street from North Sheridan Boulevard to North Lowell Boulevard, as well as pavement, striping, signage, sidewalk, and curb and gutter.

CDOT owns the Clear Creek bridge itself, as well as the parcel containing the Clear Creek Trail just east of Clear Creek and north of West 52<sup>nd</sup> Avenue.

Denver has several inlets collecting tributary drainage from Jefferson County (on the north side of West 52<sup>nd</sup> Avenue) into Denver's storm sewer system between Clear Creek and North Sheridan Boulevard, which outlets into the east abutment of the Clear Creek bridge.

Likewise, Denver has several inlets collecting tributary drainage from Adams County on the north side of West 52<sup>nd</sup> Avenue into Denver's storm sewer system between North Lowell Boulevard and the outfall east of the bus shelter at the low point at the Willis Case Golf Course, which outlets to the northwest, through Adams County to a point near I-76 and North Sheridan Boulevard, north of West 52<sup>nd</sup> Avenue.

The City and County of Denver's stormwater policy is typically to not accept stormwater flows from adjacent municipalities into their system. However, since both storm sewer systems in place currently collect stormwater from Jefferson and Adams County tributary areas, and CCD's Drainage Master Drainage Plan accounts for these ROW flows in future pipe sizing, there presumably is a tacit or formal agreement in place that confirms that this variance to CCD's standard approach is acceptable. During future final design stage(s) CCD variance approvals and jurisdictional cost sharing and maintenance agreements will need to be negotiated between CCD, and Jefferson and Adams Counties. These agreements may also need to address repair and maintenance items including but not limited to street sweeping, snow plowing, and pothole/pavement repair.

## S. Typical Sections

SEH will work with the City to determine the preferred road, bike lane, and sidewalk configurations for the project. The existing roadways are classified on the 2017 City and County of Denver Street Classification map (<https://www.denvergov.org/content/dam/denvergov/Portals/706/documents/street-classification-map-2017.pdf>). West 52<sup>nd</sup> Avenue is classified as a collector with a 30 MPH posted speed limit and Sheridan Boulevard is an arterial with a 35 MPH posted speed limit. There is currently a patchwork of sidewalk in the area. Curb and gutter is also intermittent. The 30% typical section drawings, showing the existing and proposed conditions along both roadways, are available in **Appendix CC**.

### West 52<sup>nd</sup> Avenue

Along West 52<sup>nd</sup> Avenue there is curb and gutter on the south side from North Jay Street extending 300 feet east, on the south side from Benton Street to 100 feet east of Sheridan Boulevard and curb and gutter on the north side from Sheridan Boulevard to Lowell Boulevard. Along West 52<sup>nd</sup> Avenue there is detached sidewalk on the south side from North Jay Street extending 300 feet east, attached sidewalk on the south side from Benton Street to 100 feet east of Sheridan Boulevard and sidewalk on the north side from Sheridan Boulevard to Lowell Boulevard.

West of Sheridan Boulevard the City intends to construct new curb and gutter along with sidewalk on both the north and south sides while utilizing existing curb and gutter where possible. Design of the new section should take care not to block drainage behind the curb and may require the entire road section to be lowered by roughly six inches, which may affect cover over existing utilities. East of Sheridan Boulevard to Stuart Street, the City intends to utilize the existing curb on the north side and install new curb and gutter on the south side where needed, mainly along the Willis Case Golf Course. The new curb along the golf course may block drainage and a swale behind the curb with occasional sidewalk chases to allow water into the gutter or coordination with the golf course to utilize some of their property to grade the area to drain. The only improvements planned east of Stuart Street are to potentially restripe to provide parking lanes or upgraded bike lanes.

There are currently on-street bike lanes along West 52<sup>nd</sup> Avenue in both directions from Tennyson Street to Lowell Boulevard and westbound from Tennyson Street to Sheridan Boulevard. The City intends to construct a section that accommodates bike travel in both directions on West 52<sup>nd</sup> Avenue throughout the project area.

The typical section of West 52<sup>nd</sup> Avenue will need to be confirmed with adjacent stakeholders. The West 52<sup>nd</sup> Avenue right-of-way in different portions of the project area is owned and maintained by Jefferson County, Adams County, the City of Arvada, and Denver. Ideally, a single typical section can be agreed upon.

The design team prepared a preliminary layout of West 52<sup>nd</sup> Avenue in Arvada based on Denver's standard roadway cross-section appropriate to the roadway classification, as confirmed with Arvada. Later in the design

phase, Arvada determined a new future roadway cross-section and asked the design team to update the plans accordingly. The 30% roadway plans have been updated to illustrate the new roadway section, including a center median and curb head-separated protected bike lanes and attached sidewalk.

### North Sheridan Boulevard

Sheridan Boulevard has curb and gutter along the entire project area which will be removed and replaced as needed to allow for the addition of sidewalk to the corridor. Sheridan Boulevard only has attached sidewalk from Interstate 70 to the entrance to Inspiration Park. The City intends to construct sidewalk on only one side of Sheridan Boulevard. The selected side of Sheridan Boulevard will need to be designed to consider the impact to the roadway and golf course along with pedestrian comfort and safety.

Per CCD direction on January 6, 2021, the City directed that sidewalk width shall be a minimum of six feet along the Willis Case Golf Course. This applies along both North Sheridan Boulevard (east side) and along West 52<sup>nd</sup> Avenue (south side) frontages. Either the Golf Course and/or the Recreation and Parks Department would maintain these sidewalks and the width variance to ensure a minimum six-foot width will accommodate their maintenance equipment. The email from CCD providing this direction is included as **Appendix DD**.

This proposed section with a minimum 6' sidewalk on the east side of Sheridan Boulevard was presented to the City's Back of Curb Committee. The Committee recommended consideration of a standard arterial section, which would include a 12' wide tree lawn and an 8' wide sidewalk. However, this proposed section would have impacts on the Willis Case Golf Course and likely require removal of approximately 40 trees. CCD Golf indicated that the full arterial section wasn't realistic without a golf course re-design at DOTI's expense. After subsequent review by DOTI staff and follow-up discussions with CCD Golf, the City directed SEH to design the Sheridan Boulevard section using the existing roadway pavement, curb, and gutter with a **new 10' wide attached sidewalk** along the east side of Sheridan Boulevard. This design would require some retaining walls as needed for tie-ins to existing grades and a pedestrian safety fence. At the north end the retaining wall will tie to the existing wall at the SE corner of West 52<sup>nd</sup> Avenue and Sheridan Boulevard. These improvements will encroach somewhat into the golf course, but not as much as a standard arterial section would have. The City has asked SEH to identify impacts to the golf course, including a sand trap and golf green, as well as trees and irrigation as "to be relocated" with further design development at the preliminary and final design stage.

As noted in Section Q above and in **Appendix BB**, CDOT provided these comments on February 16, 2021.

"Lane widths are substandard in this segment already and CDOT R1 Traffic would like the project to seek a solution that allows for increasing of lane widths to a minimum of 10.5' uniformly and at least a 9' turn lane width. This corridor is already narrow enough and alternatives need to be considered, up to and including narrowing the proposed multiuse path, narrowing of the area to the direct East of the path, shifting of the path, retaining wall, and fence to the East to a point that would allow the construction of a wider path as Denver prefers. Willis Case Golf Course is Denver Parks property, so DOTI is encouraged to work with Denver Parks to obtain said land needed to facilitate a path as Denver has described on this 30% set. CDOT R1 Traffic agrees that a sidewalk from the WB I-70 off ramp at 48<sup>th</sup> up North to the next signalized intersection (West 52<sup>nd</sup> Avenue) is a positive improvement that we support in terms of addressing pedestrian safety, ADA accommodations, and a designated bike route. However, we need to find a solution that works for all modes of transportation navigating this segment of Sheridan."

SEH notes that the recommended project scope is to only construct the attached sidewalk to the back of the existing curb on the east side of North Sheridan Boulevard to minimize additional ROW needs from Willis Case Golf Course due to the potential for significant cost related to realignment of the adjacent golf holes. However, final plans will note the potential to reconsider CDOT's preference for a wider road section between West 52<sup>nd</sup> Avenue and Sheridan Boulevard and West 48<sup>th</sup> Avenue and Sheridan Boulevard with future final design, and the cost estimate will provide an additional conceptual level cost to make that change (assuming CCD will approve a variance to their arterial section for the indicated lanes widths during final design). Consideration should also be taken to ensure a street with wider lanes can fit through the intersection of West 52<sup>nd</sup> Avenue and Sheridan Boulevard or the intersection is also widened.

SEH will utilize the *Denver Bikeway Design* Manual which should be finalized soon to guide the design of bike facilities along West 52<sup>nd</sup> Avenue. The Denver Regional Council of Governments (DRCOG) has a database of existing traffic counts available at <https://gis.drcog.org/trafficcounts/>. SEH will obtain updated field traffic counts for the project soon. The traffic counts will be used with the Bikeway Design manual Bicycle Facility Selection Chart to determine the appropriate design. The currently available DRCOG numbers indicate that West 52<sup>nd</sup> Avenue with a 30 MPH speed and average daily traffic (ADT) counts of 5,774 and 7,389 that the appropriate facility is a Protected Bike Lane or Shared Use Path level. Sheridan Boulevard has a 35 MPH speed and ADT count of 31,237 which the chart calls for a Protected Bike Lane or Shared Use Path. There is no intention at this time to construct any dedicated bike facilities along Sheridan Boulevard.

## **T. Street Lighting**

City and County of Denver (CCD) requested SEH prepare a high-level order-of-magnitude lighting construction cost estimate associated with lighting systems along North Sheridan Boulevard and West 52<sup>nd</sup> Avenue. The project limits of the lighting estimate will mirror those currently identified in the Pedestrian Safety Improvement Project plans for new sidewalk installation. The lighting system will illuminate roadways and pedestrian facilities to enhance pedestrian safety. Lighting levels will be based upon current the CCD Street Lighting Design Guidelines & Details document (Design Guidelines). A summary of SEH's findings is presented below and additional analysis can be found in **Appendix EE**.

The preliminary design approach will be based upon traditional Xcel Energy owned lighting equipment that best suits the proposed roadway and sidewalk improvements, available right-of-way, and an understanding of proposed utility improvements and potential utility conflicts.

Estimated costs are identified and based upon Xcel Energy streetlight ownership and broken out for each agency abutting the corridor.

### **North Sheridan Boulevard (West 52<sup>nd</sup> Avenue to I-70 Off-ramp)**

The proposed lighting system along North Sheridan Boulevard is based upon the Xcel owned "Streetlight Type I" as defined in the Design Guidelines. North Sheridan Boulevard is considered an arterial roadway and will encounter low levels of pedestrian activity.

The proposed lighting along North Sheridan Boulevard is based upon a one-sided system located on the east side of North Sheridan Boulevard behind the proposed sidewalk. The typical pole consists of 35-foot pole with a 10-foot arm equipped with an Xcel type "D" LED luminaire. One-sided pole spacing is anticipated to be approximately 235 feet apart. Both sides of North Sheridan Boulevard are owned by CCD. Lighting system costs associated with this section of roadway would fall upon CCD.

### **West 52<sup>nd</sup> Avenue East of North Sheridan Boulevard (Sheridan to Stuart Street)**

This section of roadway involves two agencies, CCD along the south side and Adams County along the north side. Currently the roadway is illuminated with an Xcel owned wood pole system having luminaires placed in a staggered orientation along the roadway. The luminaires along the Adams County side are placed upon wood distribution poles. These poles are necessary to distribute power throughout the neighborhoods. Most of the luminaires along the south side are placed upon dedicated Xcel wood poles that only serve the purpose of the roadway illumination along the south side. The poles along the south side are fed with overhead conductors originating from the nearest distribution poles along the north side. The light poles along the south and north sides of the roadway are designed to work together to provide a uniformly illuminated roadway. All the luminaires along the roadway are mounted at approximately 30 feet and are the Xcel type "D" LED. West 52<sup>nd</sup> Avenue is considered a collector roadway and will encounter low levels of pedestrian activity.

The light levels generated by the current wood pole system are well above the Design Guideline recommendations for a collector roadway. The wood pole and luminaire locations along the north side are fixed and are not anticipated to change with any future construction. Considering the existing pole locations along both sides work well to illuminate the roadway, it is our recommendation to have Xcel remove the existing wood

pole system along the south side and install a new Xcel owned “Streetlight Type I” system equipped with Xcel type “D” LED luminaires in the same location as the wood poles.

Unless the CCD or Adams County have received negative feedback from residents regarding the current light levels, we recommend maintaining the current light levels along this section of roadway. We have observed neighborhood backlash on previous projects where agencies have reduced lighting levels that residents have become accustomed to.

The south side of West 52<sup>nd</sup> Avenue is owned by CCD. Lighting system costs associated with the proposed system would fall upon CCD.

### **52<sup>nd</sup> Avenue West of North Sheridan Boulevard (Sheridan to North Jay Street)**

This section of roadway involves three agencies, CCD along the south side, Jefferson County along the north side, and Arvada at the west project limits.

The north side of the roadway is cluttered with primary overhead electrical distribution. This overhead electric system conflicts with typical light pole placement. Secondary overhead distribution is located along the south side, but it is farther away from the typical proposed light pole locations. Due to the overhead conflicts associated with a two-sided lighting system, it is our recommendation to move forward with a one-sided lighting system located along the south side. To maintain light level continuity with the West 52<sup>nd</sup> Avenue lighting system east of North Sheridan Boulevard, we recommend designing to achieve lighting levels that are above those recommended in the Design Guideline for a collector roadway. We are not recommending that the light levels match that of the eastern section of West 52<sup>nd</sup> Avenue but achieve something in-between the values identified in the Design Guideline and the elevated levels found to the east. West 52<sup>nd</sup> Avenue is considered a collector roadway and will encounter low levels of pedestrian activity.

We are proposing to use the Xcel owned “Streetlight Type I” with a one-sided pole spacing of approximately 210 feet apart. Each pole would be equipped with an Xcel type “D” LED luminaire mounted at 30 feet on a 10-foot arm.

Considering the lighting system would be owned by Xcel, we anticipate that most of the installation and operation costs will be divided equally between CCD and Jefferson County, and Arvada will be responsible for a small portion at the west end of the project.

A one-sided lighting system is the least expensive option for all involved agencies. A two-sided system option would involve installing the same quantity of light poles but would double the supporting underground infrastructure.

# Denver Moves: Pedestrians & Trails



**DENVER**  
THE MILE HIGH CITY



JANUARY 2019



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## GLOSSARY

**At-grade crossing** – a level street crossing for pedestrians or for a trail (as opposed to a bridge or tunnel).

**Amenity zone** – in urban settings, the space between the back of curb and edge of sidewalk that includes tree planters, street lighting, street furniture, public art, etc.

**Arterial, collector or local street** – a common street classification system; arterial streets carry the most people and have the least access while local streets have the most access and carry the fewest people.

**Bikeway (on-street)** – a street with a designated facility for biking, such as a neighborhood greenway or bike lane.

**Census Tracts, Block Groups or Blocks** – statistical subdivisions of a county or city per the U.S. Census Bureau.

**Complete Network** – nearly all of the projects the city could complete to improve walkability or to create a world-class trails system.

**Curb ramp** – a ramp between the sidewalk and street.

**Grade-separated crossing** – a street crossing for pedestrians or for a trail that is not level with the street, such as a bridge or tunnel.

**High Injury Network** – established by Vision Zero, the 5% of Denver streets that account for 50 percent of traffic deaths.

**Parklet** – a sidewalk extension that provides more space and amenities for people using the street.

**Pedestrian Demand Index** – an approximation of pedestrian demand across the city.

**Pedestrian Hybrid Beacon (PHB, or HAWK)** – a traffic control device with two red balls above a single yellow ball that is designed to help pedestrians safely cross busy streets.

**Pedestrian Priority Areas** – areas where land use, built environment and demographic factors contribute to high levels of walking.

**Pedestrian realm** – the combined space from the back of curb to the edge of right-of-way, including the sidewalk and tree lawn or amenity zone.

**Rectangular Rapid Flash Beacon (RRFB)** – a traffic control device with two yellow rectangles that flash rapidly that is designed to help pedestrians safely cross moderately busy streets.

**Right-of-way** – an area of land owned or controlled by the city for the purposes of constructing, operating and maintaining public facilities such as streets, alleys, sidewalks, bike paths, utilities or other public infrastructure.

**Shared space** – a right-of-way design approach that minimizes separation between travel modes.

**Singletrack trail** – an unpaved trail, usually only wide enough for one user at a time.

**Skills course** – areas with challenge features for people biking such as berms, rocks, logs or ramps.

**Trail** – a facility for the exclusive use of people biking, walking, or skating; trails are usually located in their own right-of-way rather than in a right-of-way shared with a street.

**Tree lawn** – in less urban settings, the space between the back of curb and edge of sidewalk that includes a grass lawn and trees.

**Typology** – a classification according to a general type.

**Uncontrolled pedestrian crossing** – an at-grade crossing for pedestrians where drivers are not controlled by a STOP sign or traffic signal.

**WALKscope** – an online data collection tool developed by WalkDenver and PlaceMatters.

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# EXECUTIVE SUMMARY

*Denver Moves: Pedestrians & Trails* is a long-term, community-developed, and financially unconstrained plan for achieving a vision for walking and trails in Denver.

This plan was developed through the *Denverright* process and was coordinated with other relevant already-established and developing plans. Significant effort was made through *Denver Moves: Pedestrians & Trails*' development to ensure a high degree of integration between the pedestrian, bicycle, trails and transit networks. *Denver Moves: Pedestrians & Trails* identifies priorities for projects, policies and programs so that elements of the community-developed vision can be achieved as quickly and efficiently as possible.

For pedestrians, *Denver Moves: Pedestrians & Trails* identifies a Complete Network of new sidewalks, widening of existing sidewalks, at-grade crossings of streets and grade-separated crossings of major barriers such as freeways, railroads and rivers. Many design treatments contribute to a highly walkable environment, including geometric treatments, traffic signal treatments and streetscape treatments. *Denver Moves: Pedestrians & Trails* focuses on the most essential elements of a transportation system for people walking. This plan identifies the overall cost for each of these elements, along with implementation priorities. The total cost of each of these elements is:

- To complete missing sidewalks – approximately \$273 million
- To widen existing sidewalks that are too narrow – approximately \$828 million
- At-grade crossing improvements (crosswalks, beacons, signals, etc.) – approximately \$80 million

- Grade-separated crossing improvements – approximately \$139 million

For trails, *Denver Moves: Pedestrians & Trails* identifies a Complete Network of new paved trails, new singletrack trails, widening of existing trails and new and upgraded trail connections and street crossings. New and widened trails are proposed according to new trail design guidelines; these guidelines are based on national best practices and can later be adopted as standards. The total cost of each of these elements is:

- To complete new paved trails – approximately \$20 million.
- To complete high-priority connections and crossings – approximately \$110 million.
- To complete new singletrack trails and widen existing trails – approximately \$225 million.
- To complete later-priority connections and crossings - \$45 million.

Although these costs are high, having an understanding of the total cost is critical for the city to identify annual funding levels to achieve the community's vision for a walkable Denver and for a world-class trails system.

The city will use these plans to identify new capital-funded projects, grant funding opportunities and, in some cases, General Obligation Bond projects.

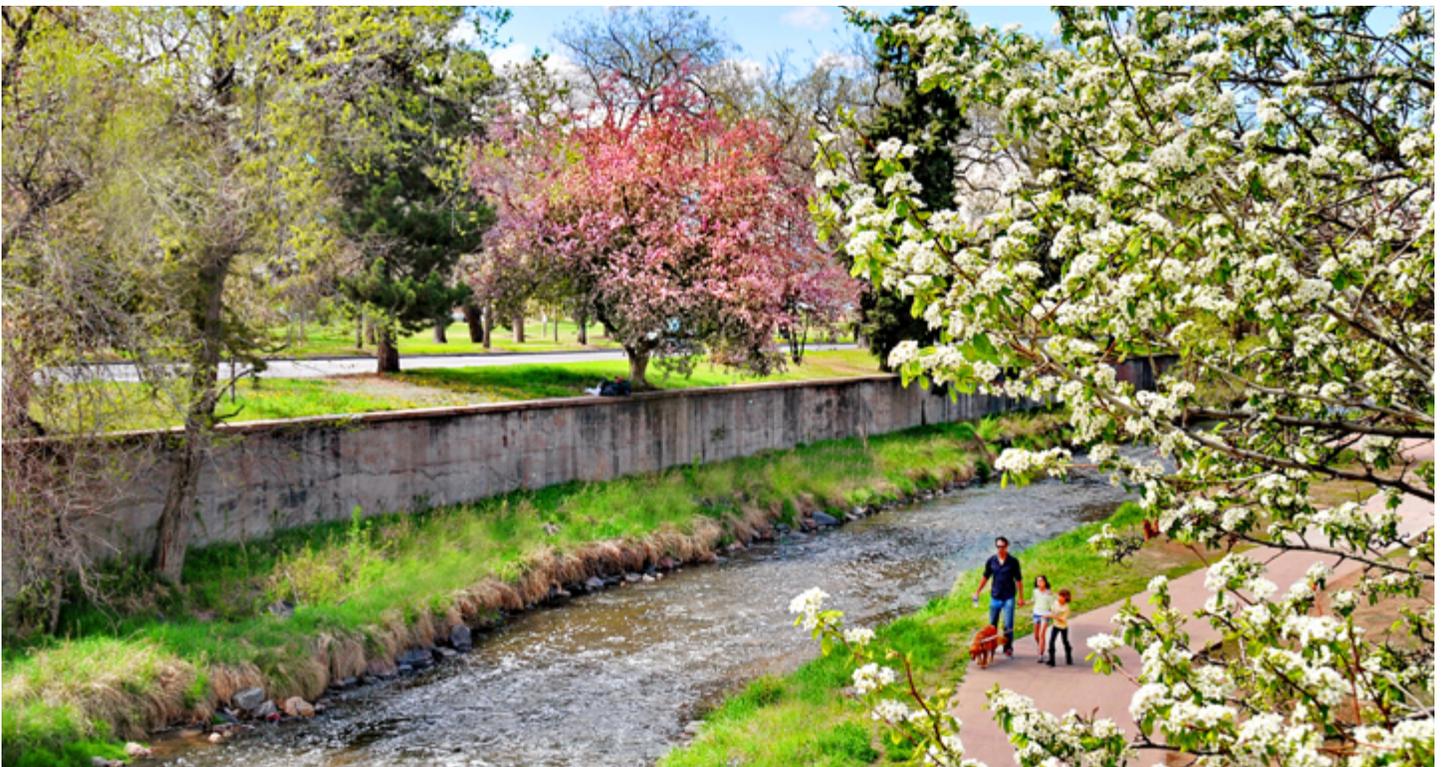
Both the pedestrians and trails elements include a variety of other useful elements and recommendations, such as planning tools, design guidelines and policy and program action plans.



## INTRODUCTION

### PLAN PURPOSE

*Denver Moves: Pedestrians & Trails* is a long-term, financially unconstrained plan for achieving a vision for walking and trails in Denver. That vision was developed and refined by people who live, work and play in Denver through an 19-month process from May 2016 to December 2017. Several City and County of Denver departments, including Public Works, Parks & Recreation, Community Planning and Public Health & Environment, will use *Denver Moves: Pedestrians & Trails* over time to implement projects, policies and programs. *Denver Moves: Pedestrians & Trails* identifies priorities for projects, policies and programs so that elements of the community-developed vision can be achieved as quickly and efficiently as possible. Achieving the vision identified in this plan will take many years, and, as Denver evolves over time, periodic updates to *Denver Moves: Pedestrians & Trails* may be appropriate.



## PLAN CONTENTS

*Denver Moves: Pedestrians & Trails* includes separate pedestrian and trails elements. Although these elements are described separately, efforts were made through their development to ensure their integration with each other and with *Denver Moves: Bicycles* and *Denver Moves: Transit*.

In addition to identifying projects, policies and programs for pedestrians and for trails, *Denver Moves: Pedestrians & Trails* includes several components that can stand alone but serve as a critical building block to this plan:

- Pedestrian Priority Areas – these are being defined by *Blueprint Denver* and represent areas where land use, built environment and demographic factors contribute to high levels of walking. They inform how a street’s design and operations should differ to serve high levels of walking.
- Pedestrian Demand Index – this is an approximation of pedestrian demand that the city can use to inform regular prioritization of pedestrian infrastructure, including for annual budgeting. The Pedestrian Demand Index is more detailed than Pedestrian Priority Areas in regards to how pedestrian demand levels vary throughout the city.
- Sidewalk types – sidewalk types address how sidewalks should be designed when meeting the city’s standards is not feasible or when planning or designing in Pedestrian Priority Areas. Future changes to the city’s design standards, rules and regulations or policies can incorporate these sidewalk types.
- Trail design guidelines – the Parks & Recreation Department will strive to achieve these design guidelines

through new trail construction and trail retrofits; upon approval by the Parks & Recreation Department these can become trail design standards.

- A policy and program action plan for pedestrians and trails – City policies or programs have a significant effect on walkability and trail infrastructure; refinements to these policies and programs ensures that they promote this plan’s vision. Changes to these policies and programs are beyond the scope of this plan so an action plan is provided so these changes can happen over time.
- Conceptual designs of high-priority trail projects – the Parks & Recreation Department will use these conceptual designs to program projects into future budgets and as a starting point for high-priority project designs.
- Key messages for a future education and outreach.
- Recommendations for how to monitor progress for both pedestrians and trails.
- Recommendations for how to integrate this plan into the *Neighborhood Planning Initiative*.

**Appendix A** includes the maps that are referenced throughout this plan.



## RELATIONSHIP TO OTHER PLANS

Various plans lay the foundation for a multimodal street system with high-quality pedestrian infrastructure and a world-class trails system. The city's *Strategic Transportation Plan*, completed in 2008, recognizes the importance of moving people, not just cars. The city's *Climate Action Plan*, completed in 2015, promotes walking and biking as a means to reduce greenhouse gas emissions and improve public health. *Blueprint Denver*, the city's coordinated land use and transportation plan, encourages expanded transportation choices to improve quality of life.

*Denver's Mobility Action Plan (July 2017) has a Strategic Goal of a combined bike and pedestrian commute mode share of 15 percent. Pedestrian and trails infrastructure and programs are critical for meeting this Strategic Goal.*

Whereas these plans set the policy direction for Denver's transportation system, Denver Moves plans are implementation-focused and provide direction as to how the city will achieve those policies. Denver Moves provides this direction through mode-specific plans that, through public engagement, identify specific projects and implementation strategies. *Denver Moves: Bicycles* was the first such plan developed. *Denver Moves: Pedestrians & Trails* was developed to be consistent with both *Denver Moves: Bicycles* as well as the forthcoming *Denver Moves: Transit*.

## DENVERIGHT

*Denver Moves: Pedestrians & Trails* is one of four plans developed concurrently through the *Denverright* process, a long-term and comprehensive planning process initiated in 2016 that also includes updates to *Blueprint Denver*, updates to *Game Plan* (the city's master plan for parks and recreation), and the first-ever creation of *Denver Moves: Transit*. The Final Draft of *Denver Moves: Pedestrians & Trails* has been coordinated with these other planning efforts and will begin informing pedestrian investments as early as January 2018. However, *Denver Moves: Pedestrian & Trails* will not become final until *Blueprint Denver* and other *Denverright* plans are completely the end of 2018.

The 2018 update to *Blueprint Denver* will identify a variety of community values, including affordable housing and transportation, great parks and open space and transportation choices. Additionally, a forthcoming policy of *Blueprint Denver* is that pedestrians be treated with dignity on every street and that every street should have a safe place to walk. *Blueprint Denver* is developing a new street typology with goals for safety, context-sensitivity to land use and economic development potential and person-mobility. The new street typology classifies arterial and collector streets as Downtown, Main Street, Mixed-use, Commercial, Industrial or Residential and identifies high-level guidance for the design and operation of these streets, as well as modal priorities for specific streets or specific areas. Some of this guidance addresses aspects of a street's design and operation that influence its pedestrian-friendliness.

As of December 2017, *Game Plan* has identified several

Preliminary Strategies with a strong relationship to pedestrian infrastructure and trails: expand and diversify the urban forest; improve access to parks; and protect legacy parkways and expand green streets. *Denver Moves: Pedestrians & Trails* aims to complement these Preliminary Strategies in a variety of ways through its recommendations.

Lastly, *Denver Moves: Transit* will identify several Proposed Transit Corridors for a range of high-capacity transit and transit speed and reliability improvements. *Denver Moves: Pedestrians & Trails* recognizes the importance of high-quality walkways and crossings as a first and last mile access strategy and its recommendations are coordinated with the locations of Proposed Transit Corridors.

### 2004 PEDESTRIAN MASTER PLAN

The 2004 *Pedestrian Master Plan* identified recommendations and priorities for infrastructure, policies and programs. The recommendations and priorities of the pedestrian component of *Denver Moves: Pedestrians & Trails* replace those from the 2004 *Pedestrian Master Plan*.

### PLAN PROCESS

*Denver Moves: Pedestrians & Trails* was developed between May 2016 and December 2017. The first half of the plan development process included public engagement to understand the community's vision and goals for walking and trails, as well as existing conditions data collection and analysis. The second half of the plan development process included network development and prioritization as well as additional public engagement to verify that the plan's proposed projects, policies and programs align with the community's vision and goals.

### PUBLIC ENGAGEMENT

People who live, work and play in Denver were engaged throughout the entirety of the *Denver Moves: Pedestrians & Trails* development process. Specifically, public engagement was completed through the following mechanisms:

- The city formed a Task Force of citizens, agency representatives, advocates and elected officials; this Task Force met seven times through the plan's development to review draft plan components and to ensure that the plan reflected community values.
- In summer 2016 *Denver Moves: Pedestrians & Trails* gathered input through an online survey shared amongst the *Denverright* plans.
- In fall 2016 *Denver Moves: Pedestrians & Trails* initiated its own online survey to understand the community's vision and goals for walking and trails; additionally, *Denver Moves: Pedestrians & Trails* participated in five *Denverright* open houses throughout the city in October 2016.



- To engage underserved communities in the plan's development, City staff and consultants worked with community leaders to identify locations and events where they could engage non-English speaking communities, low-income communities and youth.
- In winter 2016 several Task Force members completed additional public engagement of underserved communities via a paper survey.
- In August and September 2017 *Denver Moves: Pedestrians & Trails* completed a follow-up online survey, series of five open houses and underserved community engagement effort to review the draft plan's contents and to ensure that the plan would convey a community-supported vision.





## PEDESTRIAN ELEMENT

### VISION, STATEMENT OF PURPOSE, GOALS & PERFORMANCE MEASURES

#### VISION

*The vision for the pedestrian network of the City and County of Denver is one that provides residents, employees and visitors with a walkable environment that is safe and comfortable for all users and treats all users with dignity. The pedestrian environment will be well-connected with a complete set of sidewalks and crossings that access key destinations including transit stops and stations, parks and grocery stores. These facilities will be accessible to all users by complying with Americans with Disabilities Act (ADA) guidelines. Walking will be a safe mode of transportation and activity for all ages. The pedestrian environment will not only create a comfortable walking experience, but serve as a beautiful, clean and well-lit space that promotes healthy living.*





## STATEMENT OF PURPOSE

*Denver Moves: Pedestrians & Trails establishes a Complete Network of pedestrian facilities including new sidewalks, widening of existing sidewalks, at-grade crossings of streets and grade-separated crossings of major barriers such as freeways, railroads and rivers. The Complete Network represents nearly all long-term projects the city could complete to improve walkability. The Complete Network relies on a series of sidewalk and crossing types that will create a comfortable, safe system of pedestrian facilities that flexibly incorporates new pedestrian facilities into existing, constrained street rights-of-way. Denver Moves: Pedestrians & Trails prioritizes elements of the Complete Network so staff from Denver Public Works have clear direction for project implementation. Denver Moves: Pedestrians & Trails estimates the overall funding need to buildout the Complete Network, along with a portrayal of how long buildout will take at different funding levels and how those different funding levels affect the goals and objectives derived from community input.*



## GOALS & PERFORMANCE MEASURES

Pedestrian-related goals were derived from community input. Each goal is followed by a performance measure so that the goals are measurable and so that progress can be tracked over time. *Performance measures are written in italics following each goal.*

### **Goal 1: Accessibility**

A pedestrian system with a complete network of well-maintained, ADA-compliant sidewalks, walkways and crossings for users of all abilities.

*Percent of sidewalks complete ( $\geq 4$  feet) throughout the city.*

### **Goal 2: Connectivity**

A complete, connected sidewalk network without gaps and with frequent pedestrian crossings across barriers.

*Average crossing spacing of arterials and major barriers including highways, rivers and railroads.*

### **Why Use 4-foot Sidewalks as a Benchmark?**

*The United States Access Board's proposed Public Rights-of-Way Accessibility Guidelines (PROWAG) identify 4 feet as the minimum continuous clear width of pedestrian access routes, including sidewalks; however, these guidelines note that passing spaces shall be provided every 200 feet when sidewalks are less than 5 feet wide. New sidewalks in Denver will almost always be built 5 feet wide or wider but using 4 feet as the benchmark helps the city understand which sidewalks need major reconstruction to be accessible versus those that can become accessible with only minor modifications.*



### **Goal 3: Destination Access**

A complete pedestrian network with sidewalks and crossings that are up to standards and provide direct access to key destinations: transit, grocery stores, parks, schools, and health care centers.

*Percent of sidewalks complete ( $\geq 4$  feet) within  $\frac{1}{4}$  mile from bus stops and bike share stations and  $\frac{1}{2}$  mile from rail stations, parks, grocery stores, schools and health care centers.*

### **Goal 4: Equity**

A complete pedestrian network with sidewalks and crossings up to standards and without gaps within low-income areas.

*Percent of sidewalks complete ( $\geq 4$  feet) in census tracts where at least 20 percent of the population is below the Colorado state poverty level.*

### **Goal 5: Health**

A complete pedestrian network with sidewalks and crossings up to standards and without gaps within areas of health concern.

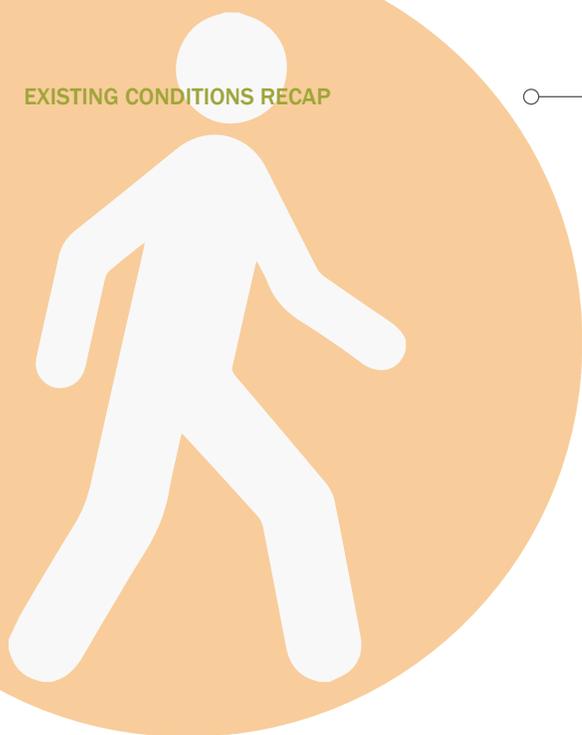
*Percent of sidewalks complete ( $\geq 4$  feet) in areas with high child obesity rates.*

### **Goal 6: Safety**

A safe network of pedestrian facilities that enables walking as a comfortable transportation mode and is designed to reduce or eliminate crashes involving pedestrians.

*Percent of sidewalks complete ( $\geq 4$  feet) along the corridors with the highest number of crashes causing injuries and fatalities, known as the High Injury Network (HIN); average crossing spacing along the HIN.*

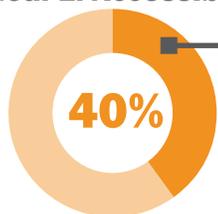




## EXISTING CONDITIONS RECAP

*The Denver Moves: Pedestrians & Trails Existing Conditions report* (May 2017) summarizes each of the pedestrian-related goals and performance measures. The Existing Conditions report establishes a baseline so that the city can measure progress moving forward. Key findings from the Existing Conditions report are:

### Goal 1: Accessibility



**40%** % of sidewalks in Denver that are either missing or too narrow (<4 feet).

- According to WALKscope, 64 percent of Denver streets for which data was available had an overall pedestrian environment rating of low to medium (scores of one to three out of five total).

### Goal 2: Connectivity

- The average signal spacing across arterial streets is 1,130 feet (over 1/5 mile).
- The average crossing spacing across barriers is 3,380 feet for freeways (almost 2/3 mile), 3,150 feet for railroads (almost 3/5 mile) and 3,600 feet for rivers (over 3/5 mile).



### Goal 3: Destination Access

Overall, 40 percent of sidewalks in Denver are either missing or too narrow (<4 feet); near key destinations, the percent of sidewalks missing or too narrow is:

- Within 1/2 mile of grocery stores – 31 percent
- Within 1/2 mile of parks – 39 percent
- Within 1/2 mile of schools – 39 percent
- Within 1/2 mile of health care centers – 35 percent
- Within 1/2 mile of light rail stations or 1/4 mile of bus stops and bike share stations – 39 percent

### Goal 4: Equity

Whereas 40 percent of sidewalks in Denver are either missing or too narrow (<4 feet), 47 percent of sidewalks in low-income areas are missing or too narrow.

### Goal 5: Health

Whereas 40 percent of sidewalks in Denver are either missing or too narrow (<4 feet), 44 percent of sidewalks in areas of health concern are missing or too narrow.

### Goal 6: Safety

- Whereas 40 percent of sidewalks in Denver are either missing or too narrow (<4 feet), only 12 percent of sidewalks along the High Injury Network are missing or too narrow.
- Whereas the average signal spacing across arterial streets is 1,130 feet (over 1/5 mile), the average signal spacing across the High Injury Network is 880 feet.

The pedestrian element of *Denver Moves: Pedestrians & Trails* identifies planning and design tools, infrastructure strategies and policy and program actions aimed at moving the city closer to its vision for walkability.

## PLANNING & DESIGN TOOLS

*Denver Moves Pedestrians & Trails* includes several planning and design tools that will inform how future pedestrian infrastructure is designed and operated. These planning and design tools are not location-specific; however, are intended to apply across a wide range of conditions throughout the city. They include Pedestrian Priority Areas, a Pedestrian Demand Index and a sidewalk typology.

## PEDESTRIAN PRIORITY AREAS

*Denver Moves: Pedestrians & Trails* was developed concurrently with *Blueprint Denver*, which creates street typologies with established modal priorities on certain streets or within certain areas. On most streets, sidewalks are necessary to treat pedestrians with dignity and provide them a safe place to walk. However, shared spaces, an approach to street design where pedestrians, bicyclists and vehicles share street space, can meet this policy in areas exempted from sidewalks (for a full description of areas exempted from sidewalks, see the section of this plan on “Areas Exempted from Sidewalks”).

*Blueprint Denver* identifies Pedestrian Priority Areas as areas where land use, built environment and demographic factors contribute to high levels of walking. Pedestrian Priority Areas are a tool to inform how a street’s design and operations should differ to serve high levels of walking. Pedestrian Priority Areas indicate places where a vibrant streetscape is desired to support economic vitality and sense of place; in these areas, the city will go beyond its policy to treat pedestrians with dignity and to provide them a safe place to walk.

At minimum within Pedestrian Priority Areas, it may be appropriate to construct a pedestrian realm (the combined sidewalk and tree lawn/amenity zone) greater than the city’s standard and to operate a street so that pedestrian convenience is paramount (such as with shorter cycle lengths at traffic signals). In the future, Pedestrian Priority Areas may also inform other streetscape design features such as pedestrian-scale street lighting, decorative crosswalks, sidewalk café design and wayfinding.

Street types from *Blueprint Denver* are used to establish Pedestrian Priority Areas. Pedestrian Priority Areas are located on Downtown Streets, Main Streets and Mixed-use Streets. To derive these street types, *Blueprint Denver* relies predominantly on a street’s existing and future Place Type (a designation established by *Blueprint Denver*) and in some cases the predominant current zoning along a street. These Pedestrian Priority Areas capture most of the streets in areas already designated as Pedestrian Priority Zone’s (Downtown Denver in 2007 and Cherry Creek North in 2014) as well as to identify other areas of the city with similar characteristics.

**Map 1** shows Pedestrian Priority Areas.



## PEDESTRIAN DEMAND INDEX

Ideally, the city would be able to use a comprehensive set of pedestrian counts to inform project prioritization. However, even with a count program, the city will not have a citywide, street-by-street understanding of pedestrian activity levels. Therefore, *Denver Moves: Pedestrians & Trails* includes a Pedestrian Demand Index. The Pedestrian Demand Index estimates the latent demand for walking based on data variables known to contribute to high levels of walking: population density, employment density and population/employment diversity. The complexities of individuals' travel decisions make it impossible to create an index that perfectly replicates real-world demand for walking; therefore, the Pedestrian Demand Index should be taken into account with planning and engineering judgment.

**Map 2** shows Denver's Pedestrian Demand Index.



## SIDEWALK TYPOLOGY

### WHAT IS A SIDEWALK TYPOLOGY?

A sidewalk typology is a set of templates that describe a desirable pedestrian environment within a range of conditions. As templates, they solve common or general issues with the pedestrian environment. A key in typology development is to solve the most common issues with a limited set of sidewalk types to ensure ease of application moving forward. The city's sidewalk typology is organized into four topic areas.

The city's *Transportation Standards and Details for the Engineering Division* (most recently updated in April 2017) apply for both new construction and retrofits. However, accommodating these standards can be difficult when retrofitting sidewalks onto existing streets. Where the city's standard cannot be achieved, the only next-best guidance for the pedestrian realm is designing to an accepted minimum (informed by the Americans with Disabilities Act), to be applied in minimal scenarios where wider facilities are infeasible. Therefore, *Denver Moves: Pedestrians & Trails* identifies Functional Retrofit Guidelines to strive for in retrofit situations along with appropriate levels of exceptions that projects must achieve to deviate from the city's standards and the Functional Retrofit guidance; these exceptions may be adopted later as a city policy.

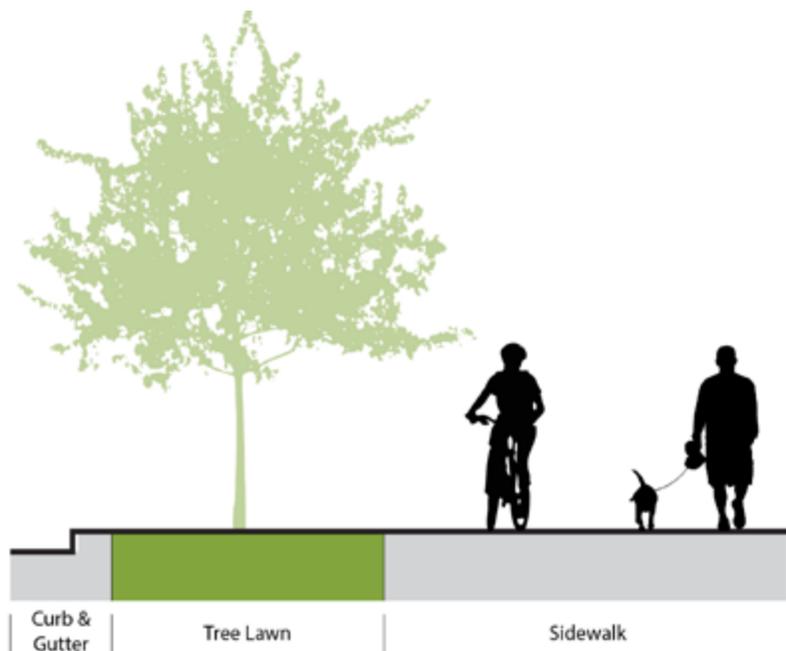




### AREA 1: CITY'S STANDARDS SIDEWALKS

The city will achieve the *Transportation Standards and Details for the Engineering Division* whenever constructing new streets and will strive to achieve these standards when retrofitting sidewalks onto existing streets. Generally, these standards are:

- On local and collector streets, a 5-foot sidewalk and 8-foot tree lawn or amenity zone
- On arterial streets, an 8-foot sidewalk and 12-foot tree lawn or amenity zone



Example of a sidewalk with tree lawn



## AREA 2: FUNCTIONAL RETROFIT GUIDELINES FOR SIDEWALKS

Where meeting the city's standards is not possible, the functional retrofit guidelines in *Denver Moves: Pedestrians & Trails* should be used to identify the preferred sidewalk type on a given street. Those guidelines are:

- On all arterial and collector streets, and on local streets with non-residential land use:
  - Where there is 7 feet of right-of-way behind the curb or less – sidewalk as wide as possible (all less than 2 percent cross slope).
  - Where there is 7-10 feet of right-of-way behind the curb – sidewalk as wide as possible (all less than 2 percent cross slope) or 5-foot sidewalk with 2-foot minimum red patterned concrete amenity zone where a steeper cross-slope is permitted.
  - Where there is 10 feet or greater – 5-foot sidewalk with 5-foot tree planter with street trees every 35 feet. In commercial areas or near bus stops tree planters may be used to accommodate pedestrian needs. Where more than 10 feet is available the sidewalk and tree lawn widths should match the city's standards as closely as possible.
- On local streets with residential land use – a 5-foot attached sidewalk is acceptable where right-of-way constraints, street trees or neighborhood character make tree lawns or amenity zones infeasible or inappropriate.



Example of a sidewalk with 2-foot minimum red patterned concrete amenity zone

## RATIONALE FOR FUNCTIONAL RETROFIT GUIDELINES

Local streets with residential land use are especially constrained rights-of-way where achieving more than a 5-foot sidewalk is difficult due to improvements either in or adjacent to the right-of-way and drainage infrastructure that would be expensive to relocate. Requiring only a 5-foot sidewalk is a practical way to serve the relatively low levels of pedestrian demand on most local streets. Additionally, not requiring a tree lawn allows for property owners to maximize landscaping and trees behind the sidewalk. In locations with mountable curb (also known as rolled curb or Hollywood curb), the city will strive to replace mountable curb with vertical curb and gutter to keep parked cars off of the sidewalk and for pedestrian safety.

On collector and arterial streets, the recommended sidewalk as wide as possible, or in some cases a 5-foot sidewalk with a 2-foot minimum red patterned concrete amenity zone, provides additional separation from pedestrians to



faster moving traffic in nearby travel lanes. The wider sidewalks or amenity zone also addresses snow storage needs and allows for passenger loading on streets with on-street parking.

### AREA 3: ACCEPTED MINIMUMS

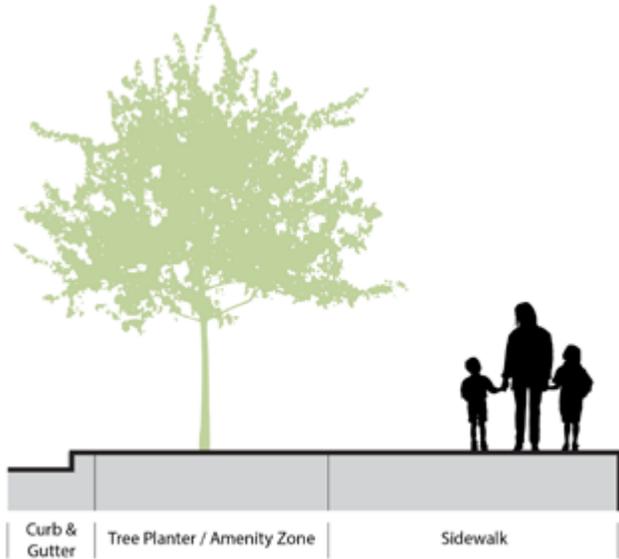
According to the Americans with Disabilities Act, the minimum continuous width of a sidewalk without passing spaces is 5 feet. This should be treated as an absolute minimum when constructing sidewalks where they are currently missing and efforts should be made to exceed this minimum per the city’s standards or functional retrofit guidelines wherever possible.

### AREA 4: PEDESTRIAN PRIORITY AREA GUIDELINE FOR SIDEWALKS

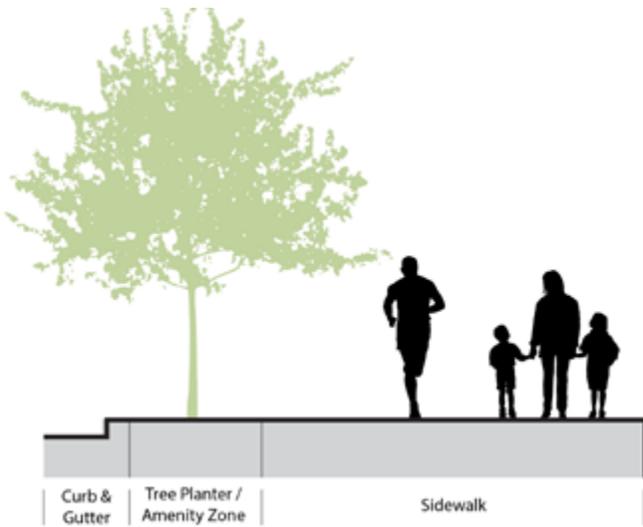
The guideline for Pedestrian Priority Areas is that the city strive for a combined pedestrian realm width of 20 feet inclusive of tree planters, sidewalk and the encroachment area (the area for privately owned improvements in the right-of-way, such as art, awnings, stairs or ramps and patios or café seating). This is intended to allow for vibrant use of the pedestrian realm within these areas. This guideline is flexible to allow for customized use of the space depending on constituent values. In some cases, a wider total pedestrian realm may be more appropriate for the highest and best use of the pedestrian realm, such as situations where a very wide encroachment area is desired for patios or café seating.

The sidewalk type for Pedestrian Priority Areas are guidelines that should be strived for in future planning and design projects. Creating a wider pedestrian realm to accommodate higher pedestrian demand is likely to cause tradeoffs within the right-of-way for travel lanes, bikeways and parking. Such future corridor planning efforts or *Neighborhood Planning Initiative* efforts can identify actual preferred cross-sections within Pedestrian Priority Areas.

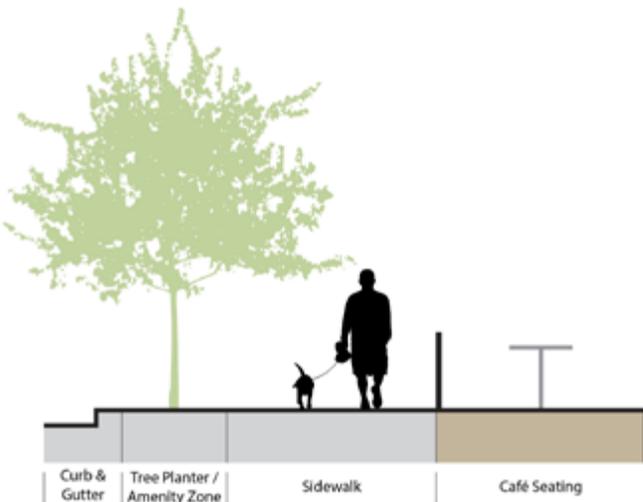




Example of a sidewalk with wide tree planter and amenity zone for additional pedestrian space outside of sidewalk



Example of a wide sidewalk with narrow tree planter and amenity zone



Example of a sidewalk arranged for café seating with narrower sidewalk and tree planter and amenity zone



## SHARED-USE SIDEWALKS

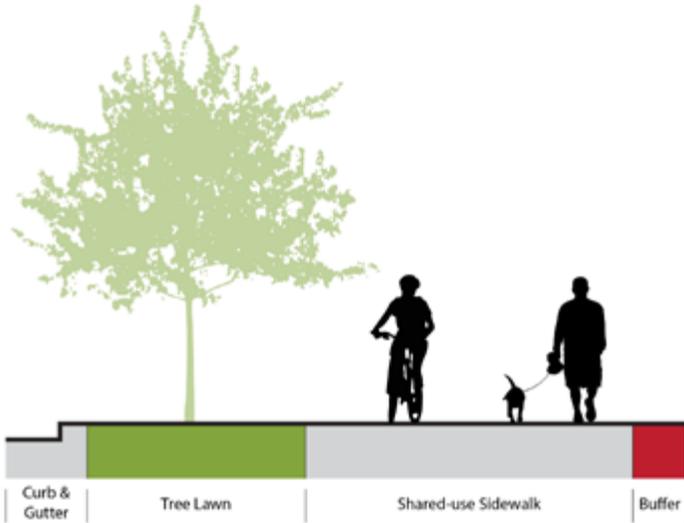
*Denver Moves: Bicycles* defines shared-use sidewalks (sidewalks designed for bicycle usage in addition to pedestrians). Shared-use sidewalks are only for implementation within a street’s right-of-way; when located in exclusive rights-of-way (such as a utility corridor or waterway corridor), the facility would comply with the trail guidelines, also established in *Denver Moves: Pedestrians & Trails*. The intent of this designation is as a connector facility not be implemented for extended lengths. The purpose of this category is to provide additional design guidance beyond what is provided in *Denver Moves: Bicycles*.

In general, the guideline for shared-use sidewalks should meet minimum guidance from the American Association of State Highway Transportation Officials (AASHTO) for multi-use paths. In locations with high volumes of bicyclists and pedestrians (generally above 300 per hour) it is recommended to either provide a 12 foot shared-use sidewalk or to separate the sidewalk from the bike path. The shared-use sidewalk guidelines are:

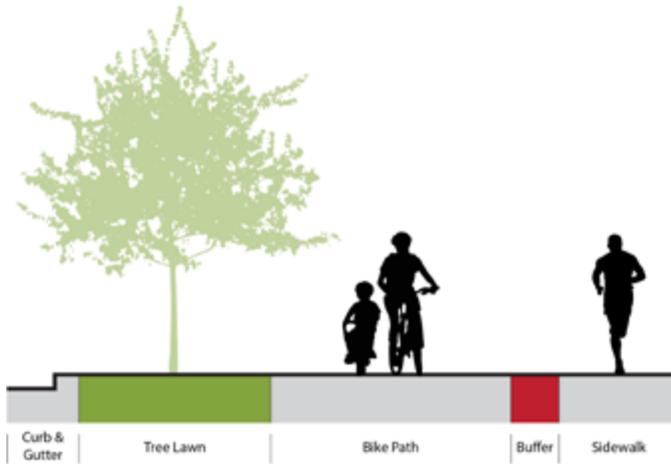
- For combined shared-use sidewalks (used by both bicyclists and pedestrians):
  - On local streets, a 10- to 12-foot shared-use sidewalk, 5-foot buffer from adjacent travel lanes and 2-foot buffer from obstructions (landscaping, poles, fences, signs, etc.).
  - On collector streets, a 10- to 12-foot shared-use sidewalk, 8-foot buffer from adjacent travel lanes and 2-foot buffer from obstructions.
  - On arterial streets, a 10- to 12-foot shared-use sidewalk, 12-foot buffer from adjacent travel lanes and 2-foot buffer from obstructions.
- For separated sidewalks and bike paths (generally only applicable on collector and arterial streets), a 5-foot sidewalk, 6-inch to 2-foot sidewalk/bike path buffer, 10- to 12-foot bike path and 8-foot buffer from adjacent travel lanes.

Note that both buffers from obstructions or between the sidewalk and bike path can either be landscaped or constructed of a textured paving material, such as colored, stamped concrete. Additionally, signage specifically aimed at reducing behaviors that result in user conflicts should be implemented on shared-use sidewalks.





Example of a shared-use sidewalk



Example of a separated sidewalk and bike path



### AREAS EXEMPTED FROM SIDEWALKS

On almost all streets, sidewalks are necessary to treat pedestrians with dignity and to provide a safe place to walk. However, there are areas of the city exempted from sidewalks, documented in *Public Works' Rules & Regulations for Sidewalk and Curb Ramp Construction* (version dated October 1, 2007). These areas meet six exemption criteria: 1. They have historic sidewalk-less design, 2. There is no internal transit, 3. There are no internal civic features (schools, libraries, parks, etc.), 4. They do not require curb ramps to provide access to adjacent properties and do not require curb and gutter to provide adequate drainage, 5. They do not provide direct connections generally consistent with the larger street grid system, and 6. Vehicular traffic volumes are low enough that pedestrians can share the street. In these exempted areas, streets should be treated as shared streets where people walking and biking share space with vehicles. These shared streets may require design interventions, such as traffic calming devices, to ensure that they treat pedestrians with dignity and provide a safe place to walk.

### SHARED SPACES

Shared spaces are an approach to street design where pedestrians, bicyclists and vehicles share street space

either at all times, at regularly scheduled times or for special events. Some shared streets feature special designs, such as curbless streets. Others may look like normal local streets but have sufficiently low traffic speeds and volumes that all users are comfortable sharing the street. Whether or not a shared space designation is appropriate, and the design of the share spaces itself, depends on a variety of factors. *Blueprint Denver* is exploring different types of shared streets and the decision-making framework for shared streets in Denver.

### DESIGN DETAILS

#### FLAGSTONE SIDEWALKS

Many older parts of Denver have flagstone sidewalks including many of Denver's landmark districts. For a description of how future rehabilitation maintenance will affect flagstone sidewalks, see the "Maintenance" section of this plan.

#### TREE LAWN OR AMENITY ZONE

Tree lawns and amenity zones describe the space between the back of curb and the edge of sidewalk. Tree lawns are typical in less urban contexts and areas with predominantly residential land uses. These consist of larger trees, usually with grass lawns, where the width of the tree lawn is sufficient for tree health. Amenity zones are typical in more urban contexts and areas with predominantly commercial or mixed-use land uses. Amenity zones feature a variety of elements including hardscape surfaces, tree planters and/or green infrastructure. A variety of urban design elements may be located in amenity zones such as tree planters, street lighting, street furniture and public art.

*Blueprint Denver's* street types will provide guidelines where amenity zones are preferred instead of tree lawns. In general, amenity zones are preferred on Downtown Streets, Main Streets, Mixed-use Streets and along certain segments of Residential Streets (depending on land use).



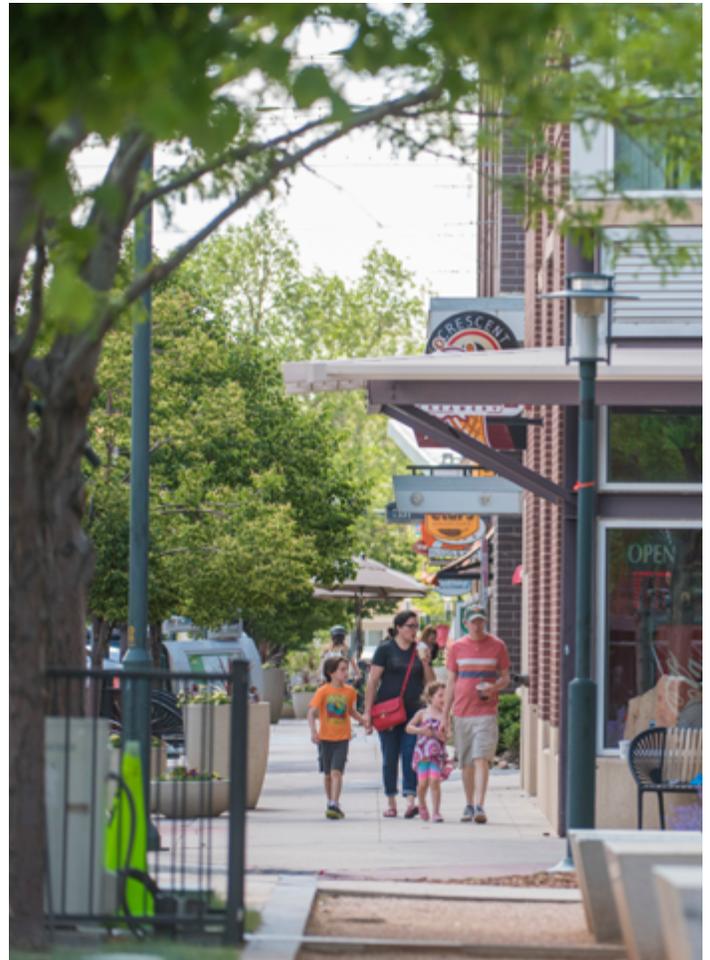
## INFRASTRUCTURE

*Denver Moves: Pedestrian & Trails* identifies priorities for essential pedestrian infrastructure elements: sidewalks, at-grade crossings and grade-separated crossings. These essential elements make up a Complete network of infrastructure. Additionally, *Denver Moves: Pedestrians & Trails* identifies additional geometric, traffic signal and streetscape treatments that contribute to walkability.

### COMPLETE NETWORK

The Complete Network for pedestrians includes new sidewalks, widening of existing sidewalks, at-grade crossings of streets and grade-separated crossings of major barriers such as freeways, railroads and rivers. The Complete Network represents nearly all long-term projects the city could complete to improve walkability. New and widened ADA-compliant **sidewalks** will be constructed according to sidewalk types that derive from the city's transportation standards or achieve a functional retrofit guideline (described in this plan) where the city's standards are not possible. **At-grade crossings** will be implemented according to the city's *Uncontrolled Pedestrian Crossing Guidelines* (September 2016) which establish a framework for evaluating candidate crossing locations and identify appropriate crosswalk treatments and geometric treatments. Lastly, **grade-separated crossings** of major barriers include pedestrian bridges, pedestrian undercrossings and walkways adjacent to streets that cross these major barriers.

A variety of other infrastructure investments will also benefit pedestrians in Denver including intersection modifications (such as curb extensions, medians or Leading Pedestrian Intervals) and other non-walkway or non-crossing improvements that benefit pedestrians (such as wayfinding). These projects are not specifically identified in *Denver Moves: Pedestrians & Trails*; however, other City efforts will identify these projects over time so that they can be prioritized and programmed for funding. These other efforts include the city's *Neighborhood Traffic Management Program* and *Vision Zero*, Denver's program for eliminating traffic-related deaths and serious injuries by 2030.





## SIDEWALKS

To fulfill Denver Moves: Pedestrian & Trails' vision for Denver's pedestrian network, this plan estimates the total funding necessary to construct Americans with Disabilities Act-compliant sidewalks on all Denver streets along with citywide priorities for sidewalk construction. The city's *Transportation Standards and Details for the Engineering Division* provide details for sidewalk construction; the city will achieve these standards when constructing new streets. A pedestrian realm (the combined sidewalk and tree lawn/amenity zone) greater than the city's standards may be appropriate or desirable in Pedestrian Priority Areas; the desire for and applicability of wider pedestrian realms can be determined through future corridor planning efforts or *Neighborhood Planning Initiative* efforts. Where the city is retrofitting existing streets to provide sidewalks, they will strive to meet the city's *Transportation Standards and Details for the Engineering Division*. Where meeting the city's standards is not possible, the functional retrofit guidelines in *Denver Moves: Pedestrians & Trails* should be used to identify the preferred sidewalk type on a given street.



## SIDEWALKS PRIORITIZATION

*Denver Moves: Pedestrians & Trails'* development established a community-driven prioritization for sidewalks in the city. In general, the city intends to complete missing sidewalks across all tiers before widening sidewalks that are too narrow. This approach is based on values identified by the community and pragmatically recognizes that having some amount of sidewalk is better than none at all.

Priority tiers are assigned in this order:

- Tier 1 projects – projects along the *Vision Zero* High Injury Network (HIN); the HIN accounts for five percent of streets in Denver, but 50 percent of traffic deaths.
- Tier 2 projects – high-frequency transit access projects; projects that are within 600 feet of a rail station, bike share station, or high-frequency bus stop or station (15 minute or better frequencies throughout the day) and have a high-priority destination (school, park, grocery store or health care center) within that 600 feet.
- Tier 3 projects – remaining high-frequency transit access projects.
- Tier 4 projects – remaining transit access projects (bus stops and stations not on the high-frequency bus network).
- Tier 5 projects – remaining high-priority destination (school, park, grocery store or health care center) access projects.
- Tier 6 projects – all remaining projects.

**Map 3** shows Tier 1-6 projects for missing sidewalks and **Map 4** shows Tier 1-6 projects for sidewalks that are too narrow.

Sidewalks may be implemented in a variety of ways, such as a stand-alone project, with ongoing street overlays, as a part of curb replacement projects or with other projects. Therefore, *Denver Moves: Pedestrians & Trails* identifies priority tiers so that the city has a narrow

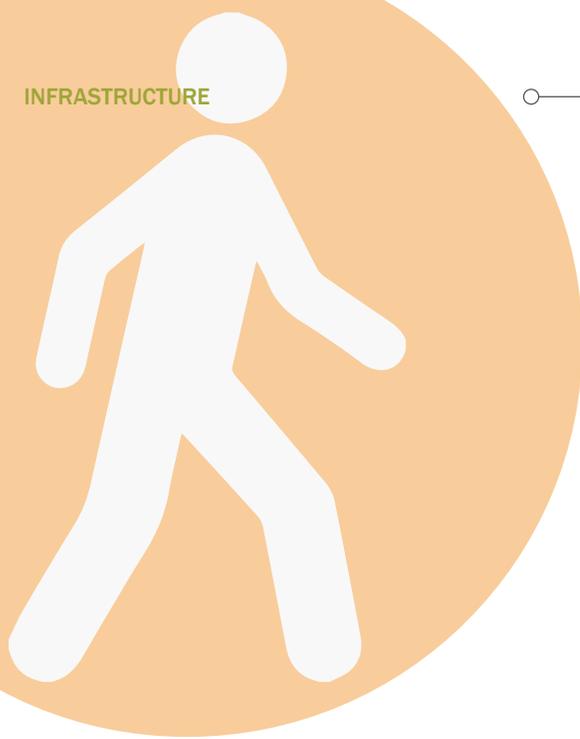
set of projects identified as priorities but can also flexibly adapt this prioritization to match sidewalk funding with overlay, curb replacement or other projects.

### 2017 GENERAL OBLIGATION BOND

Periodically, the City and County of Denver authorizes General Obligation (GO) Bonds to restore, replace, and expand infrastructure and capital assets across the city. In 2017, Denver voters authorized the 2017 GO Bond. In some cases, the 2017 GO Bond specifically identifies the locations of projects, such as sidewalks in the Globeville and Elyria-Swansea neighborhoods, a pedestrian and bicyclist bridge over the Union Pacific railroad at 47th Avenue and York Street, and reconstruction of Morrison Road. These projects are specifically shown in this plan's maps to denote that they will be implemented with GO Bond funds independent of their prioritization in this plan. In one case the GO Bond will rely on high-priority projects from *Denver Moves: Pedestrians & Trails*: the \$30.7 million identified for sidewalks to transit, including Sheridan Boulevard. These projects are not specifically shown in this plan's maps but are likely to come from the Tier 1 and Tier 2 sidewalk projects.

### SIDEWALKS COST

The total cost of completing Denver's sidewalk network is between \$800 million (at the absolute minimum type) and \$1.4 billion (achieving the functional retrofit on all City streets where sidewalks are missing or too narrow), or \$1.1 billion on average. Completing the sidewalk network will take many years and will likely require new thinking in Denver regarding funding. For illustrative purposes, five representative scenarios show how long buildout of the sidewalk network may take depending on different funding levels. Implementation will take many years and will require future policy and funding decisions.



Completing the sidewalk network will need occur through both private and public investment by leveraging opportunities with proposed development and redevelopment, capital projects, and local, regional, or state partnerships.

- \$40 million per year – 27.5 years to complete.
- \$20 million per year – 55 years to complete.
- \$10 million per year – 110 years to complete.
- \$5 million per year – 220 years to complete.
- \$2.5 million per year – 440 years to complete.

**PRIORITY TIER COSTS**

**Table 1** shows the cost of Tier 1-6 projects for missing sidewalks and sidewalks that are too narrow. The city should strive to meet the city’s standards wherever possible. However, these cost estimates assume that the Functional Retrofit Guidelines will be applied to many City streets and that accepted minimums may be necessary in some locations. These assumptions reflect the challenging complexities of retrofitting sidewalks into already-established rights-of-way.

**TABLE 1. TIER 1-6 PROJECT COSTS**

PRIORITY TIER	MISSING SIDEWALKS	SIDEWALKS THAT ARE TOO NARROW
TIER 1 PROJECTS	\$13 MILLION	\$12 MILLION
TIER 2 PROJECTS	\$44 MILLION	\$128 MILLION
TIER 3 PROJECTS	\$18 MILLION	\$49 MILLION
TIER 4 PROJECTS	\$45 MILLION	\$151 MILLION
TIER 5 PROJECTS	\$48 MILLION	\$164 MILLION
TIER 6 PROJECTS	\$105 MILLION	\$324 MILLION
<b>SUBTOTAL</b>	<b>\$273 MILLION</b>	<b>\$828 MILLION</b>
<b>TOTAL</b>	<b>\$1.101 BILLION</b>	



## ADDITIONAL PRIORITIZATION GUIDANCE

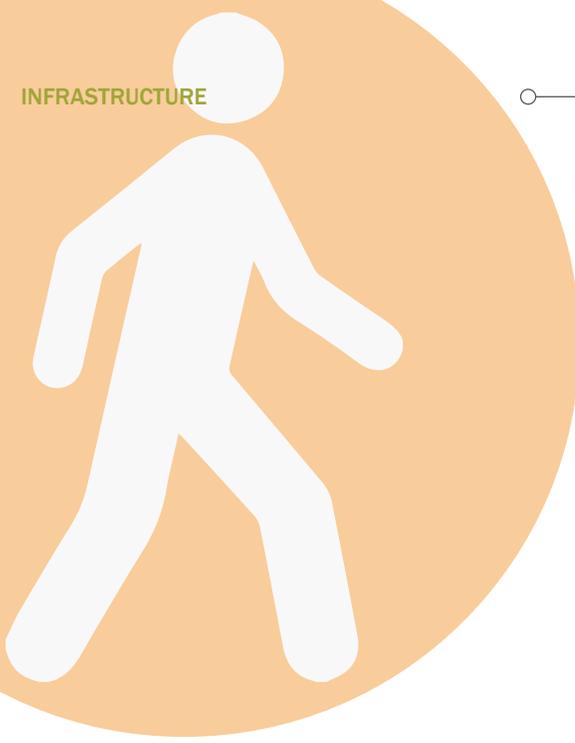
### *ACHIEVING EQUITABLE OUTCOMES*

*Denver Moves: Pedestrians & Trails'* Existing Conditions Report found that whereas 40 percent of sidewalks citywide are either missing or too narrow (<4 feet), 47 percent of sidewalks in low-income areas are missing or too narrow and 44 percent of sidewalks in areas of health concern are missing or too narrow.

Through *Denver Moves: Pedestrians & Trails'* public engagement in August and September 2017, Denverites showed a strong preference for improving sidewalks in areas of most need, including low-income areas and areas of health concern, rather than improve sidewalks evenly across all parts of the city. The city heard from almost 800 people as a part of this engagement and almost 70 percent of them indicated a preference for first improving sidewalks in areas of most need. Future decisions regarding geographic distribution of sidewalk funding should reflect this preference.

### *IMPLEMENTING PROJECTS WITHIN A TIER*

A variety of other prioritization considerations will be used to select projects from within a given prioritization tier. Within a tier, the city should further refine project selection based on possible coordination with other projects (including curb ramp construction or street maintenance such as curb and gutter replacement or overlays); matching sidewalk funding with these other projects will stretch sidewalk funding as far as possible and accelerate buildout of the Complete Network. Where no curb ramp construction or street maintenance is occurring, the city should use other datasets indicative of the need for sidewalk improvements to refine project selection within a given tier. Such datasets include, but are not limited to, Public Health & Environment's Communities of Concern model, the Pedestrian Demand Index and WALKscope.



## AT-GRADE CROSSINGS

Major streets can serve as a barrier for pedestrians if there is a lack of pedestrian crossing opportunities. Arterial streets in particular can pose barriers especially if they are multi-lane or have high operating speeds. Analysis of existing conditions found that traffic signal spacing across arterials is currently 1,130 feet, over  $\frac{1}{8}$  mile (currently, marked crosswalks across arterials almost exclusively exist at traffic signals).

The city's *Uncontrolled Pedestrian Crossing Guidelines* serve as a policy to guide staff in determining where and how to improve an uncontrolled crosswalk. The *Uncontrolled Pedestrian Crossing Guidelines* provide guidance to determine if a marked crosswalk is appropriate at a particular location; they then identify a range of enhancement treatments that may be appropriate depending on the site characteristics. For a location to be appropriate, the *Uncontrolled Pedestrian Crossing Guidelines* include a requirement for minimum pedestrian crossing demand. This criterion was derived based on Federal Highway Administration (FHWA) research and practices observed in peer, pedestrian-friendly cities.

Where demand suggests that a marked crosswalk is appropriate, the city intends to implement crosswalks

with appropriate enhancement treatments as funding is available. However, without having pedestrian crossing counts comprehensively throughout the city, *Denver Moves: Pedestrians & Trails* cannot identify specific locations for new at-grade crossings. Instead, *Denver Moves: Pedestrians & Trails* estimates the overall level of funding necessary to implement devices at a target crossing spacing according to the city's *Uncontrolled Pedestrian Crossing Guidelines*.

An analysis of one year's worth of crosswalk requests from Denver citizens was analyzed according to the city's *Uncontrolled Pedestrian Crossing Guidelines*. On average, requests that meet the criteria for marked crosswalks result in an average crossing spacing of 900 feet (approximately  $\frac{1}{8}$  mile) on arterial and collector streets. A further analysis of traffic volumes, street lanes and operating speeds was completed to determine the breakdown of traffic signal/Pedestrian Hybrid Beacon (PHB) devices, Rectangular Rapid Flashing Beacons (RRFBs) or markings/signing/medians. 900 feet should not be viewed as a goal as the city intends to implement crosswalks with appropriate enhancement treatments where justified by the *Uncontrolled Pedestrian Crossing Guidelines*. As such, this estimate may need to be revised in the future as additional crossings are implemented.

### ■ On arterial streets:

- $\frac{1}{3}$  of new crossings are expected to require a traffic signal or Pedestrian Hybrid Beacon (approximately 130 traffic signals or PHBs required).
- $\frac{1}{2}$  of new crossings are expected to require Rectangular Rapid Flashing Beacons (approximately 200 RRFBs required).
- Remaining new crossings are expected to require markings, signing and medians; medians may not be feasible in all locations (approximately 70 marking/signing/median installations required).



■ On collector streets:

- ¼ of new crossings are expected to require Rectangular Rapid Flashing Beacons (approximately 90 RRFBs required).
- ¾ of new crossings are expected to require markings, signing and medians; medians may not be feasible in all locations (approximately 260 marking/signing/median installations required).

■ On local streets all crossings are expected to require markings, signing and medians. New crossings on local streets are expected to be rare due to the *Uncontrolled Pedestrian Crossing Guidelines*' criterion that accounts for pedestrian delay.

The cost to implement all of the devices described above is approximately \$80 million. These devices will only be implemented where the *Uncontrolled Pedestrian Crossing Guidelines*' criteria are met.

## DECIDING WHERE TO PRIORITIZE NEW CROSSINGS

Prioritizing new crossings in Denver happens in two steps. In the first step, a new crossing location is identified and evaluated for whether or not it meets the *Uncontrolled Pedestrian Crossing Guidelines*. Once a location meets the guidelines, it is prioritized among other crossings that also meet the guidelines to determine order for funding and implementation.

## IDENTIFYING NEW CROSSING LOCATIONS

Since the finalization of the *Uncontrolled Pedestrian Crossing Guidelines* the city has primarily taken a reactive role in identifying new crossing locations by evaluating citizen requests for new crossings. Moving forward, the city will take a proactive role in identifying new crossing locations that are most required to improve safety for people walking. The city will study high-priority corridors and individual locations; these are corridors and locations that are on the *Vision Zero* High Injury Network and have a relatively high distance between signalized crossings (greater than ¼ mile). **Map 5** shows high-

priority study corridors for at-grade crossings.

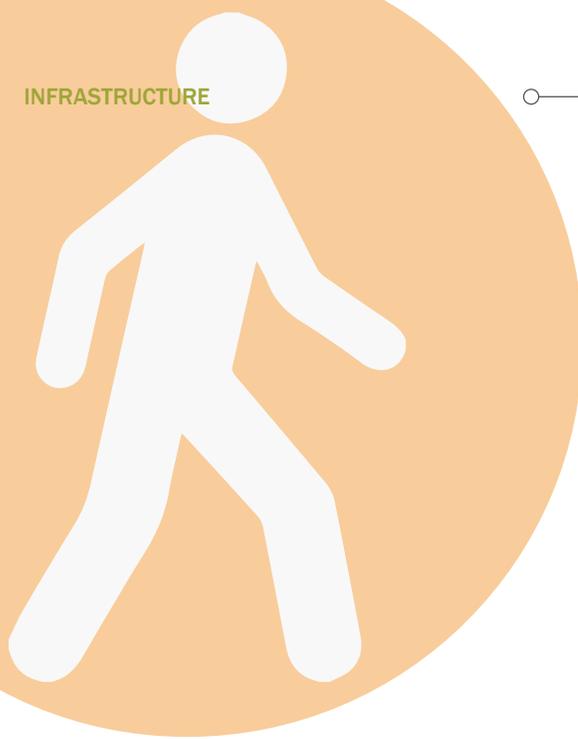
## PRIORITIZING NEW CROSSINGS

Once a location meets the guidelines, it should be prioritized among other crossings. As safety should be paramount in funding and implementing new crossings, the city should establish prioritization criteria that give an indication of the safety concern of pedestrians crossing at a particular location. This prioritization should reflect three primary criteria:

■ Pedestrian crash history – locations with a known crash history involving pedestrians crossing the street should generally be funded and implemented before locations without a known crash history. There is no specific number of crashes that qualify as a crash history, rather, crash history includes one or more crashes involving pedestrians crossing the street where no reasonable alternative exists and where the problem is likely to occur again without intervention. “Near misses” may also be an indicator for crash history and some of this information may be available through past and ongoing planning efforts, such as *Vision Zero*.

■ Pedestrian-vehicle conflicts – many locations will not have had pedestrian crashes occur in the past. Using the number of pedestrian-vehicle conflicts as an indicator for the potential for crashes to occur in the future is a reasonable way of prioritizing crossings. This could simply account for the peak hour number of pedestrian crossings and the peak hour number of vehicles on the street.

■ Distance to nearest crossing – if comparing two locations with a similar crash history and number of pedestrian-vehicle conflicts, distance to the nearest crossing is a reasonable criteria to use to identify a higher priority crossing.



## GRADE-SEPARATED CROSSINGS

The three main barriers in the street grid for pedestrians are freeways, railroads and rivers. These barriers may result in a significant amount of out-of-direction travel for pedestrians. Currently, the average spacing of crossings with pedestrian facilities for all three of these barriers is over 3,000 feet (almost  $\frac{3}{8}$  mile).

A number of grade-separated crossings have been proposed through various planning efforts, including neighborhood plans, station area plans, corridor studies or other location-specific area plans or master plans. Some of these crossings are funded through the 2017 General Obligation Bond and others are funded through the Central 70 Project. Others are proposed by this plan for the first-time where significant gaps exist or where the public identified the need for a grade-separated crossing. Through this process, 35 proposed grade-separated crossings (not including GO Bond and Central 70 projects) were identified throughout the city.

## PRIORITIZATION

These 35 crossing locations were prioritized into three tiers based on three inputs: population density in the census block that the crossing is within, employment density in the census block that the crossing is within, and distance between existing crossings along the barrier that the proposed crossing goes over or under. The population density and employment density inputs are the same inputs used for the Pedestrian Demand Index. Each crossing received a score (one through five) based on natural breaks in the data for each of the three inputs, resulting in final summed scores of three through 15. Crossings in census blocks with higher population or employment density received a higher score. Crossings at rivers, railroads or highways with longer distances between bicycle/pedestrian crossings received a higher score. Crossings then fell into a tier based on natural breaks in the final, summed score.



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## DESCRIPTIONS

### TIER ONE

**1. 47th Avenue at BNSF Railroad:** This will be a new overpass over the BNSF Railroad at 47th Avenue. This will connect a wholesale and warehouse center on the west to 41st & Fox Station and a food and event center on the east.

**2. Brighton Boulevard to National Western Drive at the railroad:** This will be a new overpass over the railroad to connect Brighton Boulevard on the east to National Western Drive on the west connecting manufacturing and auto parts stores, as well as the United States Postal Service at Brighton Boulevard.

**3. 31st Avenue at the railroad, Platte River and I-25:** This is three, or potentially four, distinct separated crossings. At I-25, this will be a new overpass. This overpass may potentially need to continue over the widened BNSF railway. Over the Platte River, this will be improvements to an existing overpass. Over the railroad, this will be a new overpass. This will likely only happen with redevelopment of the parking lot and other development to the east of the railway allowing the continuous travel for bicyclists and pedestrians along 31st Street.

**4. 42nd Avenue at the railroad:** This will be a new overpass over the railroad connecting single family homes and mixed retail along E 42nd Avenue on either side of the railroad.

**5. 23rd Street/Water Street at I-25:** This will be an overpass over I-25 along 23rd/Water Street, an improvement to the existing sidewalk infrastructure and addition of new sidewalk infrastructure on an existing overpass. This will connect the Jefferson Park neighborhood with residential and retail, Fishback Park, and the Downtown Aquarium.

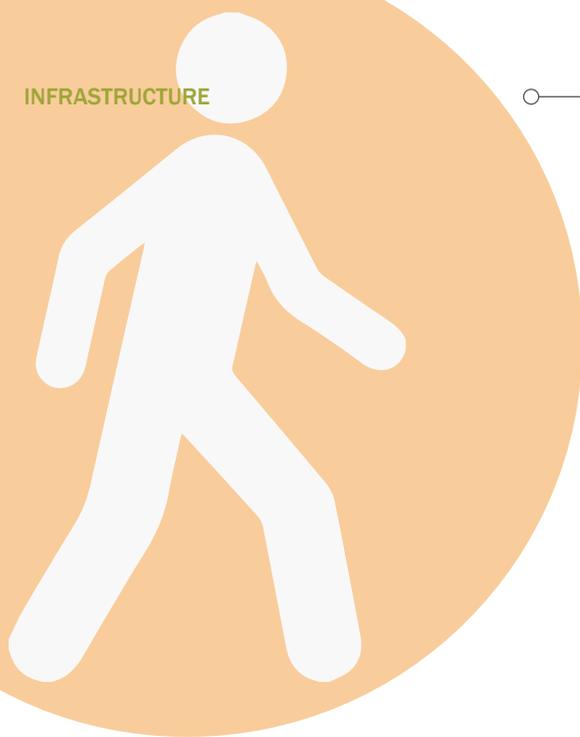
**6. 13th Avenue at the railroad (Consolidated Main Line):** Although not grade-separated, this project includes significant pedestrian enhancements to the at-grade crossing of Consolidated Main Line railroad at 13th Street. This will connect Lincoln Park and the Auraria Campus Athletic Complex and surrounding suppliers of various products.

**7. 10th Street at the railroad (Consolidated Main Line):** This will be a new overpass over the railroad at 10th Street. It will pass over three sets of railways and connect Denver Water, the Boys & Girls Club of Metro Denver, and suppliers and manufacturing industries to 10th & Osage Station and the Denver Housing Authority and Child Care Center.

**8. 8th Street at South Platte River and I-25:** This will be an underpass under I-25 and an overpass of South Platte River along 8th Street that is an improvement to the existing sidewalk infrastructure. This will connect Frog Hollow Park, Denver Housing Authorities, and Denver Water, as well as surrounding buildings in the manufacturing and supply industry.

**9. Mississippi Avenue at the railroad:** This will be an underpass under the two railways that is an improvement to the existing sidewalk infrastructure. This connects dense residential development along South Broadway and the Athmar Park/Ruby Hill neighborhoods.

**10. I-25 & Broadway Station at the railroad (Consolidated Main Line) and South Platte River:** This will be a new overpass connecting I-25 & Broadway Station to Vanderbilt Park. This will require the redevelopment of the I-25 & Broadway Station Area to be feasible.



TIER TWO

**11. Tennyson Street at I-70:** This will be an underpass under I-70 along Tennyson Street, an improvement to the existing sidewalk infrastructure. This will connect Berkeley Park, Centennial Elementary School and a shopping center to the south to Willis Golf Course to the north, as well as single family homes on both sides.

**12. Lowell Boulevard at I-70:** This will be an underpass under I-70 along Lowell Boulevard, an improvement to the existing sidewalk infrastructure. This will connect single family homes on the north to Rocky Mountain Lake Park on the south, also improving access to Centennial Elementary School.

**13. Irving Street at I-70:** This will be a new overpass over I-70 along Irving Street. This will connect single family homes and open space on the north of I-70 and to Rocky Mountain Lake Park on the south. This will require the redevelopment of single family homes on the north side of I-70 to allow an overpass to be feasible.

**14. 35th Street/Arkins Court at South Platte River to Ringsby Court:** This will be a new overpass over the South Platte River on 35th Street. This will connect Arkins Court and Ringsby Court connecting a preschool, Open Air Academy, and retail space on the west to mixed use retail, food service, and event space on the east, as well as the Denver Police Department fleet services.

**15. 38th Street at the railroad:** This will be an improvement to an existing underpass connecting 38th & Blake Station to parking for the station and surrounding mixed use development.

**16. Milwaukee Street at the railroad:** This will be a new overpass over the railroad connecting single family homes and mixed retail along Milwaukee Street on either side of the railroad.

**17. Garfield Street at the railroad:** This will be a new overpass connecting Garfield Street over the railroad that connects 40th & Colorado Station to an industrial area on the north side. Construction of the bridge will depend on redevelopment of the site north of the railroad.

**18. South Platte River Trail at the South Platte River, aligned with the Aquarium:** This will be a new overpass connecting two sides of the South Platte River Trail to each other and the Downtown Aquarium.

**19. South Platte River Trail at the South Platte River, south of Speer Boulevard:** This will be a new overpass connecting Centennial Gardens and Fishback Park and the two sides of the South Platte River Trail to each other.

**20. 7th Street at the railroad (Consolidated Main Line):** This will be a new overpass over the Consolidated Main Line railroad at 7th Street. It will connect



the Pepsi Center parking lot with Elitch Gardens and Pepsi Center/Elitch Gardens light rail station.

**21. 11th Avenue at South Platte River:** This will be a new overpass over the South Platte River at 11th Avenue. This will connect surrounding mixed use manufacturing and suppliers on the east and west of the river, as well as the Weir Gulch Trail and affordable housing. Fairview Elementary School is also on 11th Avenue west of the river.

**22. Bayaud Avenue at South Platte River and I-25:** This will be a new overpass over I-25 and the South Platte River at Bayaud Avenue. This will connect Valverde Park to west Baker.

**23. W Virginia Avenue at I-25 and railroad and Platte River:** This is three, or potentially four, distinct grade-separated crossings. At I-25, the railroad, and the river, these will be new overpasses. There is currently no existing bridge or underpass infrastructure. This will connect Alameda Station and large retail on the east and the residential single family home neighborhood and the Athmar Park neighborhood on the west of the river.

**24. South Broadway at I-25:** This will be an underpass under I-25 along South Broadway, an improvement to the existing sidewalk infrastructure. This will connect single family homes to the north and south and connect the Merchants Park Shopping Center and I-25 & Broadway Station.

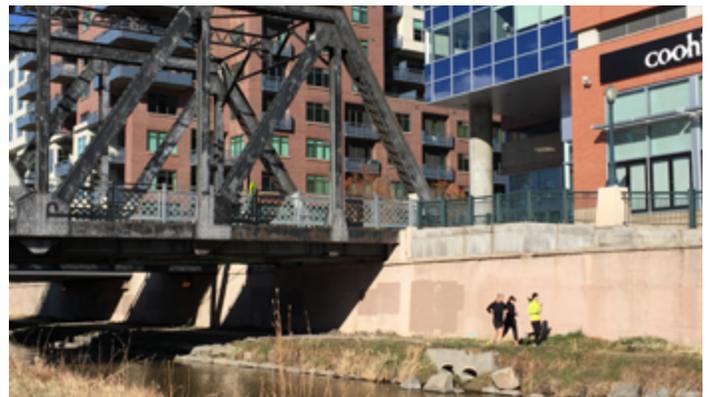
**25. Iowa Avenue at the railroad (Consolidated Main Line):** This will be an underpass under the railroad, an improvement to the existing sidewalk infrastructure. This will connect Overland Golf Course, Overland Pond Park, Ruby Hill Park and Aqua Golf to the residential single family home neighborhoods to the east and the Fleming Mansion park area.

**26. Evans Avenue at US 85 and the railroad (Consolidated Main Line):** This will be an overpass along Evans Avenue over the railroad and US 85. This will be an improvement to the existing overpass and sidewalk infrastructure. This will connect Evans Station to Overland Golf Course, Overland Pond Park, Aqua Golf, Pasquinel's Landing, and the surrounding single family homes and nearby Ruby Hill Park.

**27. Iliff Avenue at US 85 and the railroad (Consolidated Main Line):** This will be a new overpass along Iliff Avenue over the railroad and US 85. This will connect single family homes and Grant Frontier Park, as well as various machine and auto shops.

**28. High Street at I-25:** This will be a new overpass from High Street south of I-25 over I-25 to University of Denver Station, Veterans Park, the All-City Stadium, and South High School. This will connect over the railroad and US 85. This will connect single family homes and Grant Frontier Park, as well as an industrial area.

**29. Huron Street to South Platte River Trail at railroad:** this will be a new overpass from Huron Street over the railroad to the South Platte River Trail connecting Cuernavaca Park and residential and retail in the Lower Downtown neighborhood.





### TIER THREE

**30. Sheridan Boulevard at I-70:** This will be an underpass under I-70 along Sheridan Boulevard, an improvement to the existing sidewalk infrastructure. This will connect Berkeley Park, Lake Rhoda and a shopping center to the south to Inspiration Point Park and Willis Golf Course to the north, as well as single family homes on both sides.

**31. Clay Street at I-70:** This will be a new overpass over I-70 along Clay Street. This will connect single family homes on the north and south sides of I-70 and improve access to Beach Court Elementary School on the north and a daycare, Children's Corner Learning Center, on the south. This will likely require the redevelopment of single family homes to allow an overpass to be feasible.

**32. 49th Avenue at the railroad:** This will be a new overpass over the railroad at 49th Avenue. This will connect single family homes and open space on the west to a collection of trucking, restaurant, and auto supply shops.

**33. Alameda Avenue at the railroad (Consolidated Main Line):** This will be an underpass under the two railways and the green space along Alameda Avenue, that is an improvement to the existing sidewalk infrastructure. This will connect Alameda Station to the river via Alameda Avenue and to housing north of Alameda Avenue.

**34. Mississippi Avenue at South Platte River:** This will be an overpass over the South Platte River, that is an improvement to the existing sidewalk infrastructure. This connects dense residential development along South Broadway and the Athmar Park/Ruby Hill neighborhoods.

**35. S Raleigh Street at US 285:** This will be an underpass under Hampden Boulevard along S Raleigh Street. This will be an improvement to the existing sidewalk. This will connect single family homes and Gabin Elementary School to Bear Creek Park and Mullen High School.

**36. Buchtel Boulevard at Colorado Boulevard:** This will be an overpass over the railroad along Colorado Boulevard along Buchtel Boulevard that is an improvement of existing conditions. It connects various restaurants, retail stores, entertainment and a hotel.

**Map 6** shows priority tiers for grade-separated crossings.



## COSTS

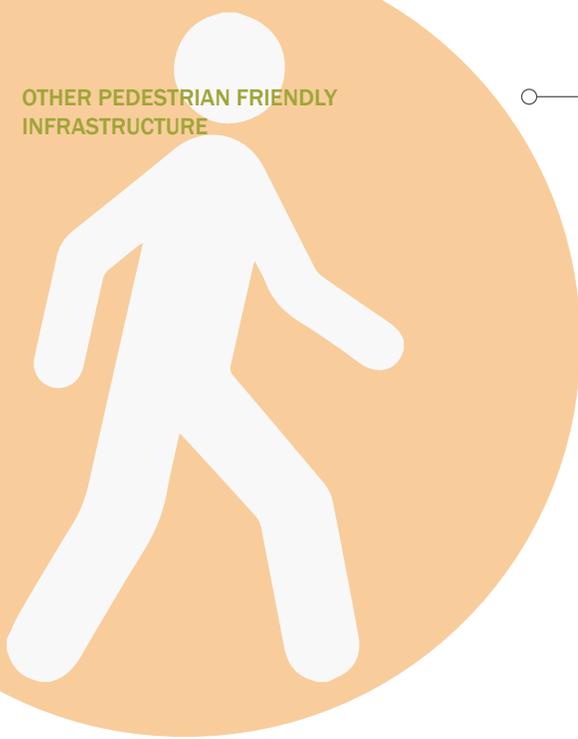
The cost of grade-separated crossings varies significantly based on site conditions, ramp configuration (graded ramps, bridge ramps, elevators, etc.). Including minor items, design, contingency, construction management and inspection, grade-separated crossings are likely to range from \$350 per square foot for a basic grade-separated crossing to \$520 per square foot for a signature crossing designed for aesthetics. **Table 2** shows the cost of Tier 1-3 grade-separated crossing projects assuming the average of the basic and signature grade-separated crossing estimates.

**TABLE 2. TIER 1-3 GRADE-SEPERATED CROSSING COSTS**

<b>PRIORITY TIER</b>	<b>COST</b>
TIER 1 GRADE-SEPERATED CROSSINGS	\$56 MILLION
TIER 2 GRADE-SEPERATED CROSSINGS	\$68 MILLION
TIER 3 GRADE-SEPERATED CROSSINGS	\$15 MILLION
<b>TOTAL</b>	<b>\$139 MILLION</b>

*Note: Estimates do not include projects #10 and #31, as these will likely require redevelopment.*

## OTHER PEDESTRIAN FRIENDLY INFRASTRUCTURE



## OTHER PEDESTRIAN-FRIENDLY INFRASTRUCTURE

Many design treatments in addition to sidewalks and crossings contribute to a highly walkable environment, including geometric treatments, traffic signal treatments and streetscape treatments. While *Denver Moves: Pedestrians & Trails* focuses on the most essential elements of a transportation system for people walking, it is important to acknowledge the city's role in providing these other treatments.

## GEOMETRIC TREATMENTS

### **Pedestrian Refuge Island (or Median)**

Pedestrian refuge islands are located in the center of streets, separating traffic of opposite directions, with a pedestrian path provided perpendicular to the street being crossed. Pedestrian refuge islands provide the opportunity for pedestrians to cross the street in two stages. Pedestrian refuge islands are already allowable in Denver and are recommended in the city's *Uncontrolled Pedestrian Crossing Guidelines*.

### **Curb Extension**

Curb extensions are elongations of the sidewalk that narrow the street, shortening the crossing distance for pedestrians and making pedestrians more visible to traffic. Curb extensions are most compatible in locations with on-street parking and are recommended in the city's *Uncontrolled Pedestrian Crossing Guidelines*.

### **Reduced Corner Radius**

Vehicles travel faster through turns with a large turn radius than turns with a small curb radius. Reducing the radius of a corner curb is an effective way of reducing vehicle speeds. Corner radii design should acknowledge that on-street parking increases effective turn radius and that large vehicles can turn into multiple receiving lanes, if available.

### **Free Right-turn Lane Design**

Free right-turns allow drivers to turn right on red without stopping. Since drivers are never controlled by the traffic signal, pedestrians must always treat crosswalks across a free right-turn lane as an uncontrolled crosswalk. Controlled right-turn movements are preferable for pedestrians because they require a driver to stop on red before turning right. Where "pork-chop" islands that channelize right-turns are necessary to provide acceptable turning radii, raised crosswalks are an enhancement for pedestrians.

### **Raised Crosswalk**

Raised crosswalks are speed tables (flat-topped speed humps) outfitted with crosswalk markings and signage, providing pedestrians with a level street crossing. By raising the level of the crossing, vehicles drive more slowly through the crosswalk and pedestrians are more visible to approaching motorists. At signalized intersections, they are most appropriate where "pork-chop" islands separate channelized right-turn lanes from the adjacent through lanes.



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## Traffic Calming

Traffic calming encompasses a variety of nonphysical, volume control and speed control measures (including both horizontal and vertical devices). Traffic calming is intended to increase safety for all street users by reducing traffic speeds and in some cases volumes.

## SIGNAL TREATMENTS

Each of the following signal treatments of operational measures is allowable per the *Manual on Uniform Traffic Control Devices*. In some cases, a recommended decision-making framework for a treatment or operational measure is included as **Appendix B** in this plan.

### Pedestrian Countdown Signal

Pedestrian countdown signals give pedestrians “Walk” and “Don’t Walk” signals and inform them how long they have to cross the street. Research suggests that pedestrians are more likely to obey the “Don’t Walk” signal when delivered using a countdown signal.

### No Right-turn on Red

When attempting to turn right on red, vehicles must look left to see if the street is clear; vehicles often do not look right before turning and may not see pedestrians to their right. Restricting right-turns on red can reduce conflicts between vehicles and pedestrians. Blank out turn restriction signs are more effective than conventional “No Right Turn on Red” signs. “No Right Turn on Red” signs that specify time-of-day restrictions or “When Pedestrians are Present” are confusing to motorists and are often disregarded.

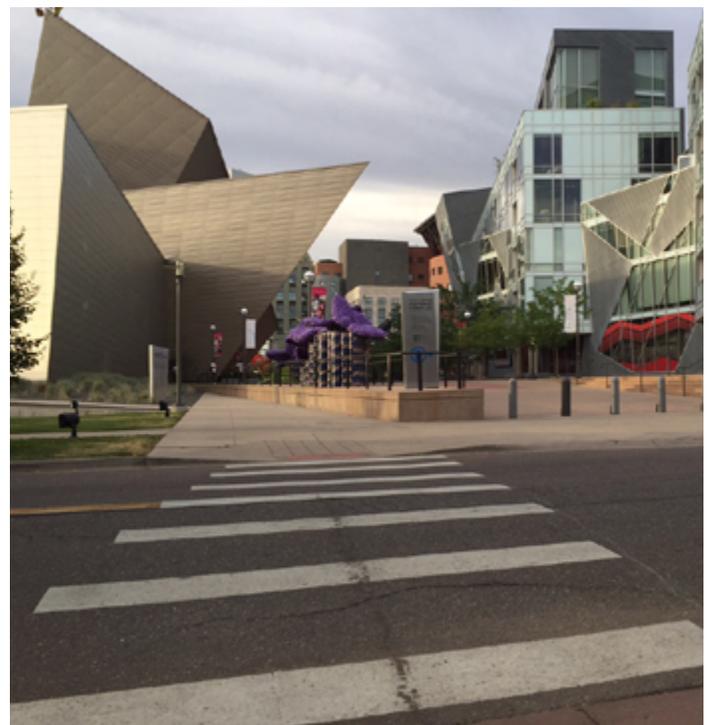
### Protected Left- or Right-turn

Where left- and right-turns are permitted at the same

time as pedestrians in the crosswalk, turning vehicles can conflict with pedestrians in the crosswalk. Making left- or right-turns protected, so that they are only allowed with a green arrow exclusive from the “Walk” signal, reduces the risk of turning vehicles conflicting with pedestrians in the crosswalk. A recommended decision-making framework for protected left- and right-turns is included in **Appendix B**.

### Pedestrian Scramble (or Barnes Dance)

Pedestrians usually have to cross two streets to get from one corner of an intersection to the opposite corner. A scramble phase allows a pedestrian to cross diagonally. These previously existed in downtown Denver and are sometimes called a Barnes Dance, after Henry Barnes, Denver’s first traffic engineer. Right-turn on red for vehicles should be restricted during the walk phase to ensure pedestrian safety. A recommended decision-making framework for pedestrian scrambles is included in **Appendix B**.





### Short Cycle Lengths

Long cycle lengths at signalized intersections result in long pedestrian wait times to cross a street. By shortening an intersections cycle length, pedestrians do not have to wait as long to cross after pushing the button to request a “Walk” signal.

### Leading Pedestrian Intervals

The “Walk” signal at a crosswalk usually begins at the same time that through-vehicles in the same direction receive a green light. A leading pedestrian interval advances the “Walk” signal for a few seconds while through-vehicles continue to receive a red light. By allowing pedestrians to get a head start into the crosswalk, it can reduce conflicts between pedestrians and turning vehicles.

### Blank-out Turn Restriction Signs

The ubiquity of conventional turn restriction signs, usually for no right-turn on red, contributes to their disregard by motorists. Blank out turn restriction signs, usually for no right-turn on red, activate only when the specified movement is prohibited.

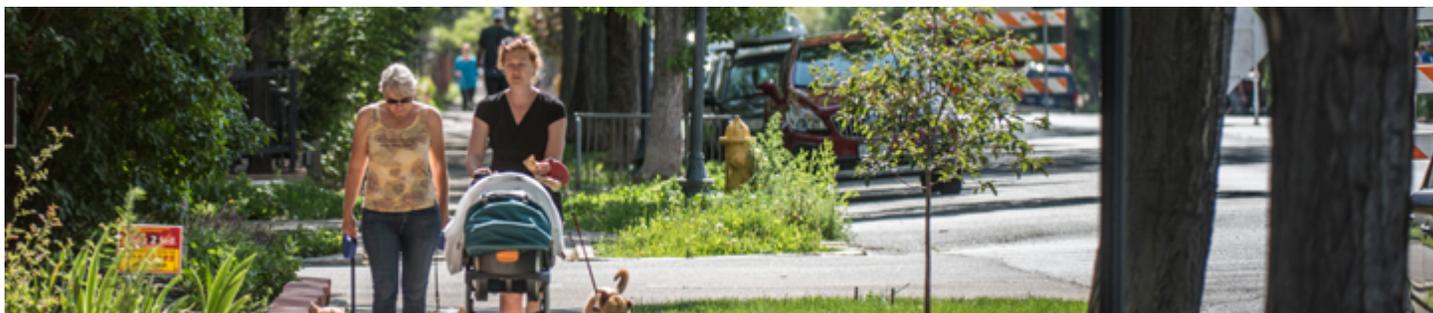
### Pedestrian Recall

Pedestrian recall gives pedestrians a “Walk” signal at every cycle. No push-button or detection is necessary since a “Walk” signal will always be given. Pedestrian recalls are useful in areas with high levels of pedestrian activity. They demonstrate that an intersection is meant to serve both vehicles and pedestrians. In general, pedestrian recall should be used if pedestrians actuate a “Walk” signal 75 percent of the time during three or more hours per day. A recommended decision-making framework for pedestrian recall (or its opposite, actuated signals) is included in **Appendix B** to this plan.

## STREETSCAPE TREATMENTS

### Street Trees

Street trees may be located in a median or in a tree lawn/amenity zone. Street trees beautify a street and provide several environmental and quality-of-life benefits, including stormwater treatment, reducing urban heat island effects, visually narrowing a street to calm traffic and reducing noise impacts of traffic to adjacent properties. Denver’s street trees are under regulation of the City Forester, but their maintenance is a responsibility of adjacent property owners.



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## Green Infrastructure

Green infrastructure refers to a network of parks, open spaces, drainageways, and floodplains which help mitigate the impacts caused by impervious (hard) surfaces. The city's *Ultra-Urban Green Infrastructure Guidelines* recommend a variety of devices in urban contexts that integrate with the pedestrian realm: streetside and bulbout stormwater planters, green gutters, green alleys and tree trenches.

## Street Lighting

Street lighting improves walkability at night: people walking can see better and are better seen by people driving. Street lighting exists on many scales, including street-oriented lighting (intended to light a street) and pedestrian-scale lighting. The city's *Street Lighting Design Guidelines* provide luminaire specifications, technical information and guidance for new streetlight installation and streetlight replacements.

## Street Furniture

Street furniture collectively includes objects and equipment installed along streets, often in the amenity zone, including benches, bollards, mail boxes, street lights, bus shelters, and public art. In Denver, street furniture is maintained either by the owner itself (such as the US Postal Service maintaining mail boxes or RTD maintaining bus shelters), by adjacent property owners (sometime in the form of a Business Improvement District), or by the city. Some street furniture is governed by Public Works' *Rules & Regulations for Encroachments in the Public Right of Way*.

## Wayfinding

Wayfinding refers to information systems that guide people through a physical environment. Pedestrian wayfinding usually includes signage and maps. Wayfinding is particularly help for pedestrians in urban centers or in transportation facilities. The city is cur-



rently developing pedestrian wayfinding installation guidelines for downtown Denver that will eventually be expanded citywide.

## Café Seating

Café seating helps activate streets by creating a vibrant environment, and also helps increase the economic vitality of businesses. While activating streets, cafe seating should not prohibit the safe, comfortable, and direct path of pedestrians. Café seating in Denver is governed by Public Works' *Rules & Regulations for Encroachments in the Public Right of Way*.

## INTERSECTIONS

In addition to sidewalks, at-grade crossings and grade-separated crossings, creating a walkable environment that is comfortable for all users will require improvements to many of the city's existing crosswalks at both signalized and unsignalized intersections. Through the *Denver Vision Zero Action Plan*, the city's *Neighborhood Traffic Management Program* (NTMP) and other local planning efforts, the city is identifying safety or comfort challenges for pedestrians at intersections. Funding for these types of improvements may come through *Denver Moves*, *Vision Zero*, NTMP or other sources.

An action item from the *Denver Vision Zero Action Plan* is to develop multimodal Street Design Guidelines. These guidelines may specifically address pedestrian-friendly geometric design treatments as well as pedestrian-friendly signal hardware treatments and operational strategies. For reference, **Appendix B** includes candidate decision-making flowcharts for pedestrian scrambles (also known as Barnes Dance phases in Denver) and protected turning movements.

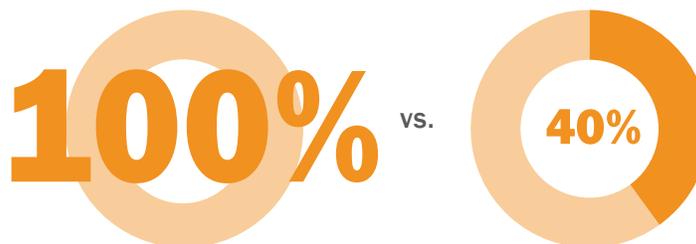




## BENEFITS OF THE COMPLETE PEDESTRIAN NETWORK

Buildout of the Complete Network will achieve the city's vision for its pedestrian system by meeting the goals derived from community input. Specific benefits of the Complete Network related to each goal are:

- Completing Denver's sidewalk network would provide accessible sidewalks on nearly all city streets, including those to key destinations, those within low-income areas and areas of health concern and those along the High Injury Network.



- Currently, the average signal spacing across arterial streets is 1,130 feet. With buildout of the Complete Network the average crossing spacing will be 900 feet (approximately  $\frac{1}{6}$  mile) on arterial and collector streets.
- Currently, the average crossing spacing across barriers is 3,380 feet for free-ways (almost  $\frac{2}{3}$  mile), 3,150 feet for railroads (almost  $\frac{2}{3}$  mile) and 3,600 feet for rivers (over  $\frac{2}{3}$  mile). Collectively, with buildout of the Complete Network the average crossing spacing across these barriers will be 2,900 feet (less than  $\frac{2}{3}$  mile).



## MAINTENANCE

*Denver Moves: Pedestrians & Trails* emphasizes the importance of funding and constructing a Complete Network of sidewalks, at-grade crossings and grade-separated crossings. This plan also recognizes the importance of maintenance, particularly of sidewalks, in creating a walkable environment that is accessible and comfortable for all users of all abilities.

Individual property owners are responsible for the routine maintenance (such as snow clearance) and rehabilitation maintenance of sidewalks (repairing cracked, heaved or otherwise out-of-compliance sidewalks). Lack of education on and enforcement of Denver's Code of Ordinances has resulted in a lack of both routine maintenance and rehabilitation maintenance of Denver's sidewalk network.

## NEIGHBORHOOD SIDEWALK REPAIR PROGRAM

Recently, Mayor Hancock, City Council and city staff worked together to pursue improvements to maintenance practices of Denver's sidewalks. The 2018 Budget includes \$4 million for the Neighborhood Sidewalk Repair Program, a program for sidewalk inspections and repairs on a region-by-region basis. The intent of this program is to address damaged, sloping and uneven sidewalks for a more accessible network of sidewalks citywide. The program includes a systematic way of identifying and addressing sidewalks in need of repair along with financial assistance to homeowners who cannot afford the full cost of repairs. Financial assistance includes extended repayment assistance and affordability discounts for those who qualify. Along with the program, the city is also authorizing less expensive repair methods not previously allowed.

## FLAGSTONE SIDEWALKS

Many older parts of Denver have flagstone sidewalks including many of Denver's landmark districts. The Neighborhood Sidewalk Repair Program will not require replacement of flagstone sidewalks that are safe and in good repair. Where the program finds that flagstone sidewalks are unsafe or in need of maintenance, property owners will have the opportunity to repair or replace flagstone sidewalks at their own cost. If replacement by the city is necessary, property owners will receive information on their options for replacing flagstone. Property owners can opt to pay the city to replace damaged flagstone sidewalks with colored concrete.

## WHAT ELSE THE CITY CAN DO

The Policy & Program Action Plan component of *Denver Moves: Pedestrians & Trails* recommends evaluation of the Neighborhood Sidewalk Repair Program so that improvements can be made to the program over time. The Policy & Program Action Plan component also recommends an education program regarding routine sidewalk maintenance such as snow clearance.



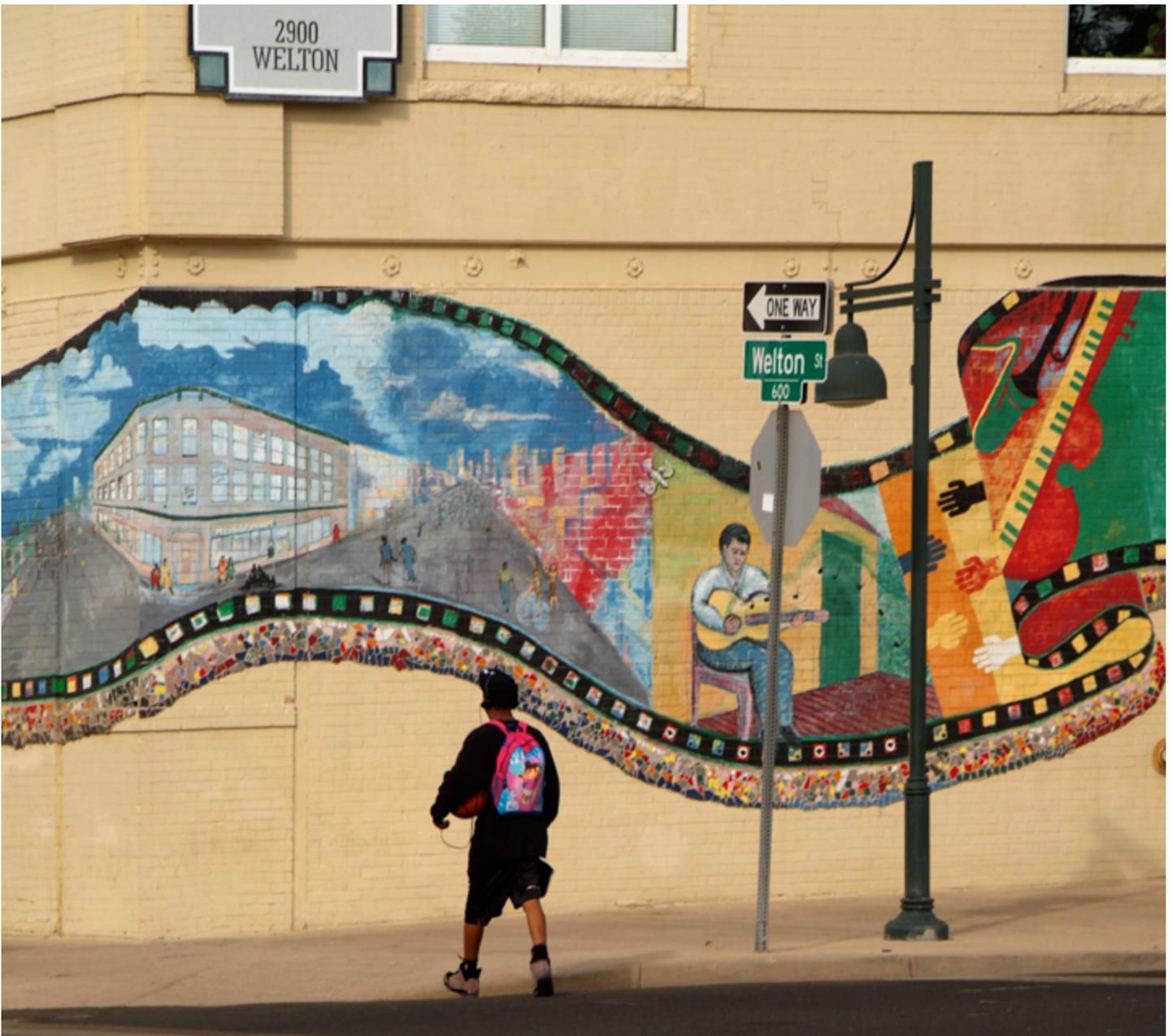
## CULTURE

Creating a walkable Denver requires more than just great infrastructure. A variety of education and encouragement efforts can also increase walking in Denver and safety for people walking. A policy and program action plan recommendation is that Public Works, Community Planning and Development and Public Health & Environment work together to identify roles in developing implementing education, encouragement and enforcement programs to promote walking. These may include programs that promote a culture of safety, as recommended by the *Vision Zero Action Plan*. These may also include Safe Routes to School efforts, demonstration or interim design projects, or other programs that leverage partnerships with local advocacy organizations.



## ALTERNATIVE FUNDING

Beyond city-derived funding such as capital improvement funds, general obligation bonds or other potential future funding sources, alternative funding can provide a significant amount of funding for pedestrian-related projects. Many of these funding sources are federally-derived and allocated directly through the Federal Highway Administration or indirectly through the Denver Regional Council of Governments. Others, such as CDOT's FASTER Safety program, are administered at the state and local levels. In many cases, sidewalks and crossings may only be a portion of a competitive project; however, the city should seek opportunities to apply for stand-alone pedestrian projects as well as projects with a pedestrian component that will be competitive for these funding sources.





## POLICIES & PROGRAMS

Investments in sidewalks, at-grade crossings and grade-separated crossings are critical for the city to achieve its vision for its pedestrian system. However, a range of policy and program actions are also necessary for the city to achieve its vision. These policy and program actions go beyond the scope of *Denver Moves: Pedestrians & Trails*; however, completing these actions is valuable for improving the quality of street design, operations and maintenance, for collecting and applying important pedestrian data to pedestrian projects, for attracting more funding, for supporting respectful user behavior and for planning for specific needs. While city staff are likely to facilitate these policy and program actions, community input on these actions is appropriate in many cases. The Mayor's Pedestrian Advisory Committee can help advise on the issues surrounding, and proposed direction for, several of these actions.

In many cases, the *Denver Vision Zero Action Plan* identifies actions that otherwise would be relevant as policy and program actions in *Denver Moves: Pedestrians & Trails*, including: holistic street design guidelines, signalized intersection hardware and operational strategies, geometric design strategies, maintaining access during construction, pedestrian-friendly speed limits, crash data and safety projects. Many of these actions are omitted from the *Denver Moves: Pedestrians & Trails* action plan to avoid redundancy.

*Denver Moves: Pedestrians & Trails* has several pedestrian-related policy and program actions, some of which are identified as high-priority based on Task Force feedback. The policies identified in this section are not intended to be a final policy recommendation, but rather a starting point for City staff to explore and further refine upon implementation.



## STREET DESIGN & OPERATION

### 1. Pedestrian-scale Street Lighting

Revise the city's *Street Lighting Design Guidelines* to provide revised guidance as to where pedestrian-scale street lighting should be considered. Whereas this document currently uses pedestrian volume as the key criteria, pedestrian-scale street lighting may be appropriate within Pedestrian Priority Areas, as defined in *Blueprint Denver*.

### 2. Shared Space Guidelines

Develop and adopt guidelines for shared spaces in public rights-of-way.

### 3. ADA Transition Plan

Develop and adopt an ADA Transition Plan that addresses the public right-of-way (including curb ramps, sidewalks and traffic signals) in addition to other City-owned facilities. Use Public Rights-of-Way Accessibility Guidelines (PROWAG) to identify opportunities for deploying ADA best practices, especially focusing on two curb ramps per corner, push button placement, and driveway cross-slope.

High-priority

### 4. Maintaining Sidewalk Width with Café Seating

Review and revise Public Works' Rules & Regulations regarding café seating in the public right-of-way to ensure that adequate space is reserved for pedestrian throughput and other streetscape elements, especially in areas with high pedestrian volumes.

### 5. Pedestrian Accommodations with Transportation Network Companies

Work with Transportation Network Company (TNC) providers (e.g. Uber, Lyft) to establish protocols for TNC operations to ensure safe pickup and drop off (such as geofences or neighborhood pickup/drop off locations). Coordinate TNC operations with pedestrian-scale wayfinding (below).

### 6. Pedestrian-scale Wayfinding

Develop and adopt guidelines for the implementation of pedestrian-scale wayfinding in the public right-of-way.

Middle-priority

<p>7. Parklet Installation Guidelines</p> <p>Develop and adopt guidelines for parklet installation within the public right-of-way that enables the city to leverage relationships with private sector partners; these guidelines may be appropriate as a part of Denver’s Community Streets Program.</p>	
<p>8. Pedestrian-related Elements of Street Design Guidelines</p> <p>Denver’s <i>Vision Zero Action Plan</i> identifies an action to develop holistic Street Design Guidelines. While these will inherently include pedestrian related elements of street design, they should also include non-safety related elements including geometric, signal and streetscape elements.</p>	<p>High-priority</p>
<p>9. Accommodations during Construction.</p> <p>Develop a policy that outlines provisions for accommodating pedestrians during construction projects that otherwise infringe on or prohibit pedestrian movement.</p>	<p>High-priority</p>

**DATA COLLECTION**

<p>10. Pedestrian Count Data and Database</p> <p>Acquire necessary equipment and develop a program to routinely collect pedestrian volume data and record it in a database, including guidance for the collection of pedestrian and bicyclist count data as a part of vehicle counts.</p>	<p>High-priority</p>
<p>11. Uncontrolled Pedestrian Crossing Database</p> <p>Develop an asset database (possibly in a Geographic Information System) of marked, uncontrolled pedestrian crossings including attribution regarding markings, signage, beacons or signal devices; develop a GIS database of traffic volumes (Average Daily Traffic at minimum) so that the city’s <i>Uncontrolled Pedestrian Crossing Guidelines</i> can be evaluated at locations citywide.</p>	<p>Middle-priority</p>



12. Database for Other Pedestrian Infrastructure

Develop additional asset databases of, or expand existing databases to include, pedestrian infrastructure including geometric, signal and streetscape treatments.

13. Sidewalks Constructed by Development

Middle-priority

Upon inspection, record and track new sidewalk constructed by development, or sidewalk that is brought into compliance through development.

**FUNDING & IMPLEMENTATION**

14. Identify and evaluate funding options for sidewalk construction on existing streets without sidewalks.

High-priority

15. Allocate annual funding to address uncontrolled pedestrian crossings or pedestrian safety-related improvements, consistent with Vision Zero's recommendations for systemic crash location review and countermeasure identification.

High-priority

16. Develop an approach to complete installation of pedestrian signal heads where missing at existing signalized intersections.

High-priority

17. Identify on the 6 and 12 year Capital Improvement Plan high-cost improvements, including grade-separated crossings of freeways, railroads, rivers and other barriers. Seek grant funding or other funding opportunities for design and construction.

High-priority

18. Sidewalk Installation with Development (New Construction or Major Renovations)

Revise Public Works' *Rules & Regulations for Sidewalk and Curb Ramp Construction* to ensure that sidewalks are being appropriately constructed with development, including new construction or renovations even if density is not changing.

High-priority



## MAINTENANCE

### 19. Neighborhood Sidewalk Repair Program Evaluation

Evaluate the efficacy of the Neighborhood Sidewalk Repair Program. Key considerations in this evaluation should include whether the program is resulting in well-maintained pedestrian infrastructure and whether the program is affordable for Denver residents and property owners. Consider modifications to the Neighborhood Sidewalk Repair Program based on the program evaluation.

High-priority

### 20. Routine Maintenance Policies

Explore limitations to the current policy on sidewalk maintenance. Examine areas where sidewalks are not regularly maintained due to property/access constraints and identify potential solutions.

High-priority



## EDUCATION, ENCOURAGEMENT & ENFORCEMENT

### 21. Maintenance Education & Encouragement

Develop an education and encouragement campaign regarding property owner responsibilities for routine maintenance (snow removal) and rehabilitation maintenance of sidewalks.

### 22. Other Education, Encouragement & Enforcement Efforts

Identify Public Works', Community Planning and Development's and Public Health & Environment's roles in developing and implementing education, encouragement and enforcement programs to promote walking, including programs that implement the city's *Vision Zero* goal, Safe Routes to School efforts, and programs that leverage partnerships with local advocacy organizations. In some cases, these may include demonstration or interim design projects. Implement education, encouragement and enforcement efforts consistent with the identified roles.

### 23. Policy Enforcement Needs Assessment

Identify resource needs to enforce policies that affect the pedestrian realm, including routine/rehabilitation maintenance violations, tree maintenance violations and other violations of rules and regulations regarding encroachments in the public right-of-way. Program funds to implement enforcement. Focus enforcement in Pedestrian Priority Areas.

### 24. Complete Streets Policy

Update Denver's Complete Streets policy so that it reflects current city transportation values and priorities, as well as national best-practices for Complete Streets policies.



## MONITORING PROGRESS

Achieving Denver’s vision for a walkable, comfortable transportation system will take time. While the pedestrian network builds out, the city can monitor its progress annually so that the Denver community, decision-makers and City staff understand the progress that the city is making towards its vision and goals.

At minimum, Denver Public Works will prepare a brief annual report of pedestrian projects completed. The annual report will identify:

- Capital (not maintenance) pedestrian projects completed and whether or not they were identified by *Denver Moves: Pedestrians & Trails*; for projects not identified by *Denver Moves: Pedestrians & Trails*, provide a description of why the project was identified and selected.



■ For each project:

□ A brief description of how the project helps achieve the goals of *Denver Moves: Pedestrians & Trails* (Accessibility, Connectivity, Destination Access, Equity, Health and Safety); for example:

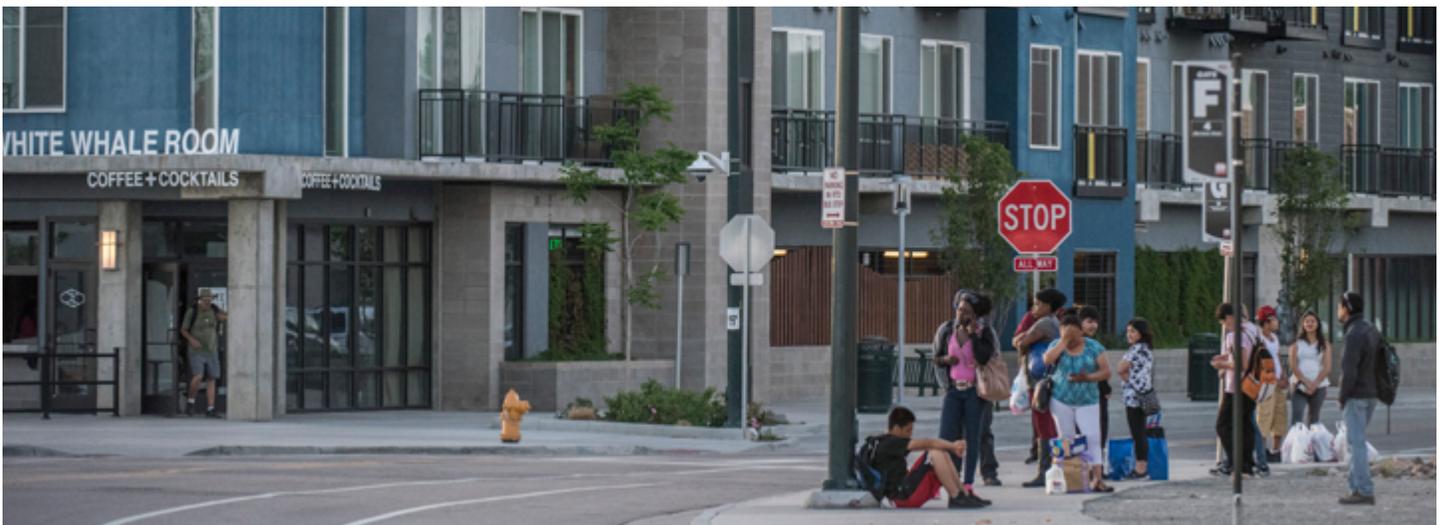
- Which projects filled in missing sidewalk segments, including gaps?
- Which projects provided access to a transit facility or high-priority destination?
- Which projects were completed in low-income areas or areas of health concern?
- Which projects were completed along the High Injury Network?

□ Identify the funding source or sources used.

■ Policy and program actions achieved.

Every two years as a part of this annual report Denver Public Works will provide some updated performance measure status per the Goals & Performance Measures identified by *Denver Moves: Pedestrians & Trails*. Specifically, performance measures to be included are:

- Citywide percent of sidewalks complete, too narrow and missing; same percentages near high-priority destinations: transit facilities, schools, parks, grocery stores; same percentages within low-income areas and areas of health concern; same percentages along the *Vision Zero* High Injury Network.
- Average signal spacing across arterial streets and along the *Vision Zero* High Injury Network.
- Average crossing spacing across barriers.



## TRAILS ELEMENT

### Vision, Statement of Purpose, Goals & Performance Measures

#### VISION

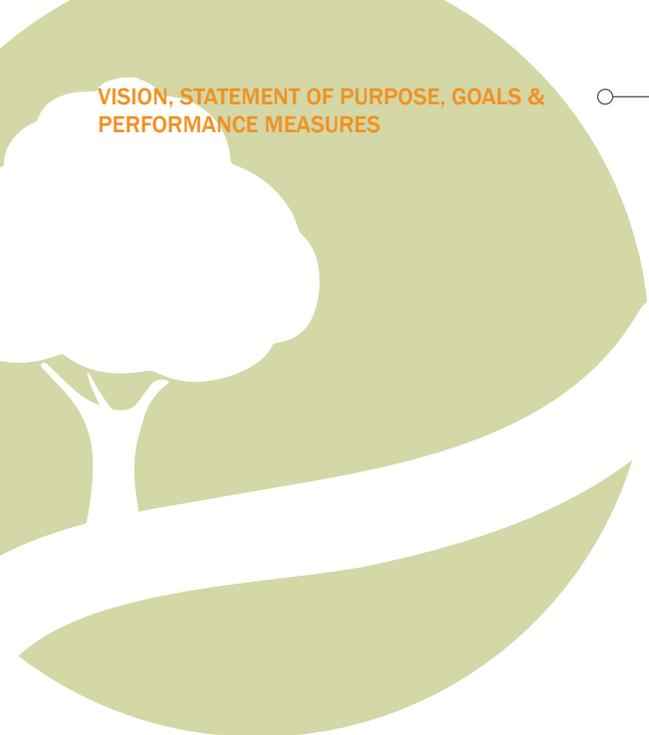
*The vision for the trails network in the City and County of Denver is one that provides residents, employees and visitors with a safe and connected set of off-street facilities that are comfortable for multiple user groups. The trails network will be accessed safely and conveniently, with a focus on connectivity to all parts of the city. Trails will provide a vital component to an integrated system of off-street trails, on-street bikeways, walkways, and transit that will create a world-class recreation and multimodal transportation network that is safe, well-maintained and beautiful in context and design. The trail network will provide connections to important destinations, direct routes throughout the city, important regional connectivity, and an opportunity for all ages and abilities to comfortably bike and walk for recreation and transportation.*





## STATEMENT OF PURPOSE

*Denver Moves: Pedestrians & Trails establishes a Complete Network for trails including new trail segments (including singletrack trail systems), widening of existing trail segments, new trail connections, street crossing upgrades, trail connection upgrades and high-priority on-street bikeway connections. The Complete Network relies on trail design guidelines and street crossing types that, when implemented, will create a high-quality trail system for users of all ages and abilities. Denver Moves: Pedestrians & Trails prioritizes elements of the Complete Network so staff from Denver Parks & Recreation and Denver Public Works have clear direction for project implementation. For high-priority projects, Denver Moves: Pedestrians & Trails includes conceptual designs of selected projects. Lastly, Denver Moves: Pedestrians & Trails identifies the overall funding need to buildout the Complete Network, along with a portrayal of how long buildout will take at different funding levels and how those different funding levels affect the goals and objectives derived from community input.*



## GOALS & PERFORMANCE MEASURES

Trails-related goals were derived from community input. Each goal is followed by a performance measure so that the goals are measurable and so that progress can be tracked over time. Performance measures are written in italics following each goal.

### **Goal 1: Connectivity**

A trail network without gaps that can be conveniently and comfortably accessed by residents and visitors biking and walking throughout the city.

*Gaps in the trail network; presence of existing and proposed, high and low ease of use bicycle facilities providing direct access to trail connections; proximity to trails and access to other high ease of use bicycle facilities; and sidewalk completion ( $\geq 4$  feet) within  $\frac{1}{2}$  mile of trail connections.*

### **Goal 2: Destination Access**

A trail network with access points and crossings that provide comfortable connections to trails from

key destinations including grocery stores, parks, schools, rail stations and bus stops.

*Density of key destinations (grocery stores, parks, schools, bus stops, rail stations) in combination with distance from the nearest trail access point.*

### **Goal 3: Equity**

A trail network that can be accessed comfortably and conveniently from throughout the city, especially low-income areas.

*Sidewalk completion around trail access points and bicycle access to trails in census tracts where at least 20 percent of the population is below the Colorado state poverty level.*

### **Goal 4: Health**

A trail network that can be accessed comfortably and conveniently from throughout the city, especially areas of health concern and can be used to access other facilities that support local health indices.

*Sidewalk completion around trail access points and bicycle access to trails in areas of high childhood obesity rates.*

### **Goal 5: Safety**

A well-maintained network of appropriately designed trails and access points that fosters a high level of personal safety, infrequent conflicts between bicyclists and pedestrians and infrequent conflicts between trail users and vehicles at street crossings and access points.

*Percent of trails that meet trail design standards; trail counts.*



## EXISTING CONDITIONS RECAP

The *Denver Moves: Pedestrians & Trails Existing Conditions* report (May 2017) summarizes each of the trails-related goals and performance measures. The Existing Conditions report establishes a baseline so that the city can measure progress moving forward. Key findings from the Existing Conditions report are:

### Goal 1: Connectivity

- There are a number of locations throughout the trails network missing segments of trail, including gaps along the Weir Gulch Trail, East Harvard Gulch Trail and other trails in the eastern part of the city.
- Within ½ mile of trail access points, 61 percent of sidewalks are complete and sufficiently wide ( $\geq 4$  feet).



- Several City neighborhoods are beyond one mile from an existing trail, especially distant neighborhoods: Skyland, City Park, Park Hill and surrounding neighborhoods; West Highland and Sunnyside; portions of Westwood and Athmar Park; portions of Washington Park; Southmoor Park, Fort Logan and Marston.

### Goal 2: Destination Access

Several trail segments have long distances between access points which makes it difficult to access nearby destinations, including segments of the South Platte River Trail, Sand Creek Trail and High Line Canal Trail.

### Goal 3: Equity

Only 50 percent of sidewalks are complete and sufficiently wide ( $\geq 4$  feet) within ½ mile of trail access points in low-income areas as compared to 61 percent within ½ mile of trail access points citywide.

Bicycle access to trails in low-income neighborhoods is slightly better as compared to citywide; 22 percent of trail access points within low-income neighborhoods are connected to an existing *Denver Moves: Bicycles* bicycle facility as compared to 19 percent citywide.

### Goal 4: Health

Sidewalk completion and width within ½ mile of trail access points are equal both in areas of health concern and citywide (61 percent).

Bicycle access to trails in areas of health concern is slightly better as compared to citywide; 24 percent of trail access points within areas of health concern are connected to an existing *Denver Moves: Bicycles* bicycle facility as compared to 19 percent citywide.

### Goal 5: Safety



Some of Denver's trails experience high user volumes. Trails with weekend day counts exceeding 1,000 users per day are: the South Platte River Trail, the Cherry Creek Trail and the Bear Creek Trail.

## INFRASTRUCTURE

### Complete Network

*Denver Moves: Pedestrians & Trails* establishes a Complete Network for trails including a variety of project types to achieve the city's vision for its trails system:

**New trail segments** include both and singletrack trails. New **hard-surface trails** fill gaps in the existing paved trail system, create new trails within or between neighborhoods, and serve new, developing areas of the city. **Singletrack trails** are typically proposed within the same corridors as hard-surface trails but create opportunities for mountain biking or trail running. The intent of the plan is to provide a series of singletrack trail facilities located throughout the city. **Skills courses** are areas along the singletrack trail corridors where challenge features are created including berms, rocks, logs, ramps and other features.

trail corridors where challenge features are created including berms, rocks, logs, ramps and other features.

**Widening of existing trail segments** are identified where trails need to be widened from their existing condition to meet the proposed design guidelines for Denver's trails.

**New trail connections** are trail access points that typically connect to a nearby street. **Trail connection upgrades** are designated in locations where the existing trail access point does not function comfortably or safely, usually where a connection could be relocated to connect to a nearby street at a traffic signal rather than mid-block. In some cases, existing connections that these replace may be future candidates for removal. Some reasons why they may be removed include directing trail users to unsafe intersections or street crossings or being spaced too close to new trail connections or to trail connection upgrades as to constitute a safety hazard for users on the trail. Removing an existing connection will not take place until the new/relocated connections are in place.

**Street crossing upgrades** are designated in locations where a trail crosses a street and may include marked crossings, flashing beacons, signals or grade-separated crossings (underpasses or bridges). In general, street crossing upgrades are identified to improve user comfort and safety. If the crossing remains at-grade, the necessary upgrades will be consistent with the city's *Uncontrolled Pedestrian Crossing Guidelines* (September 2016). Grade-separated crossings are proposed primarily at major streets where they will create a high-quality user experience by allowing trail users to completely avoid conflict with roadway traffic.

**High-priority on-street bikeway connections** are connections from the off-street trails to existing or proposed on-street bikeways from *Denver Moves: Bicycles*. These connections are especially important to create a seamless system of bicycle facilities citywide.

**Maps 7 and 8** show the Complete Trails Network.

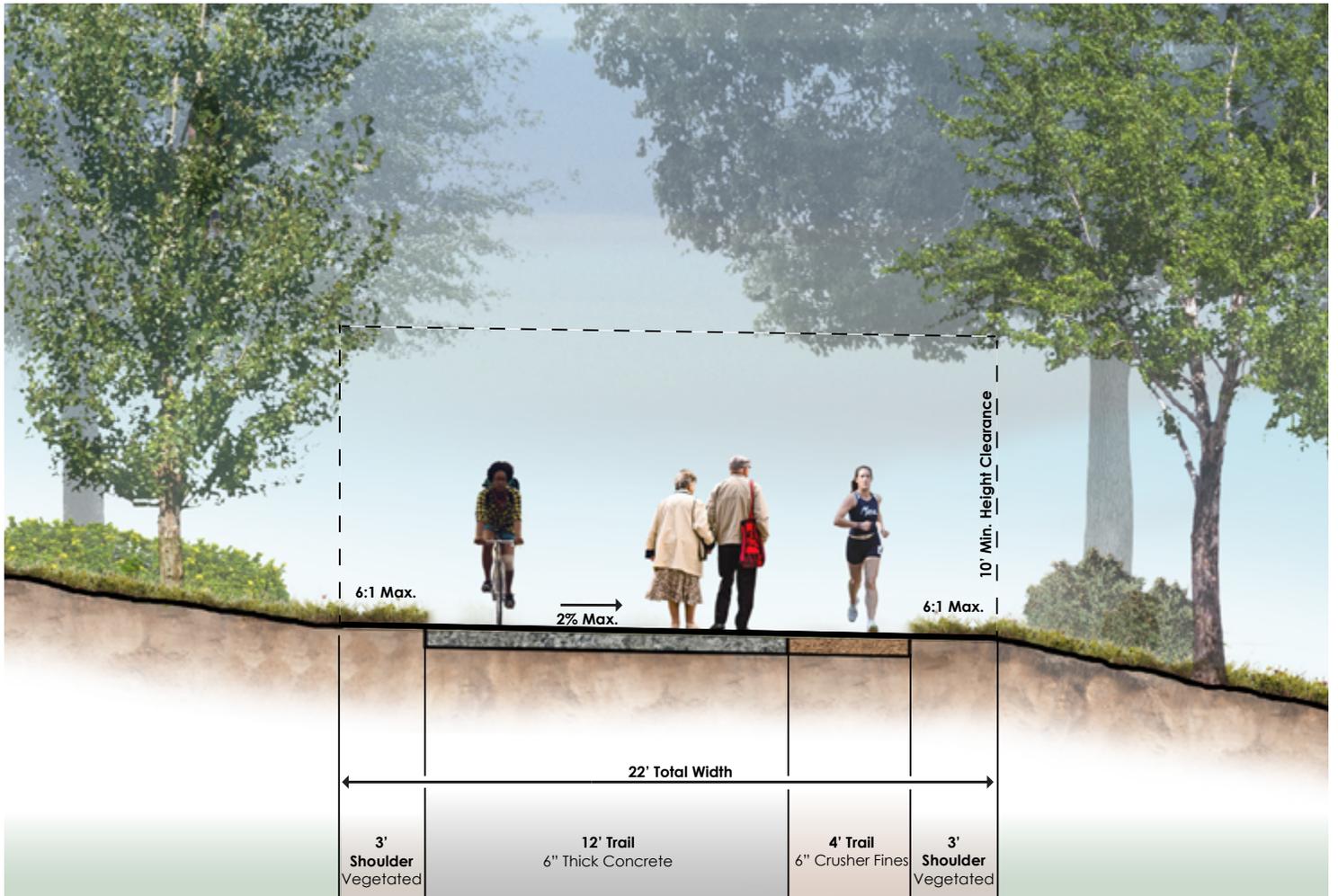


## TRAIL DESIGN

### Trail design guidelines

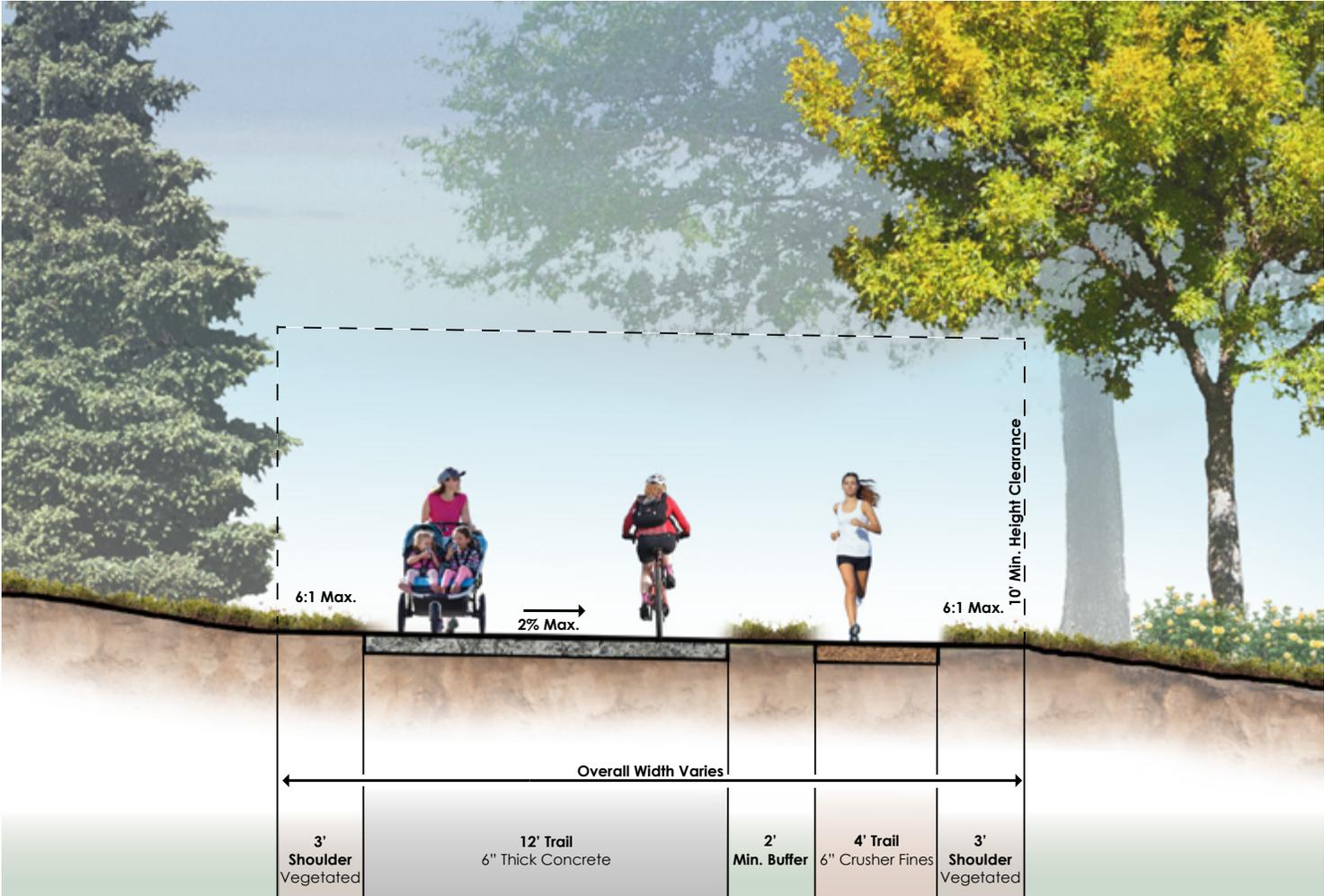
Trail design guidelines were developed through *Denver Moves: Pedestrians & Trails*. These guidelines were developed based on relevant design guidelines including AASHTO's *Guide for the Development of Bicycle Facilities, 4th Edition* and other relevant information including counts collected on the trails network and the project team's combined trails planning and design experience.

The Parks & Recreation Department will strive to achieve these design lines through new trail construction and trail retrofits; upon adoption by the Parks & Recreation Department these can become trail design standards. These trail design guidelines are summarized in the following figures.

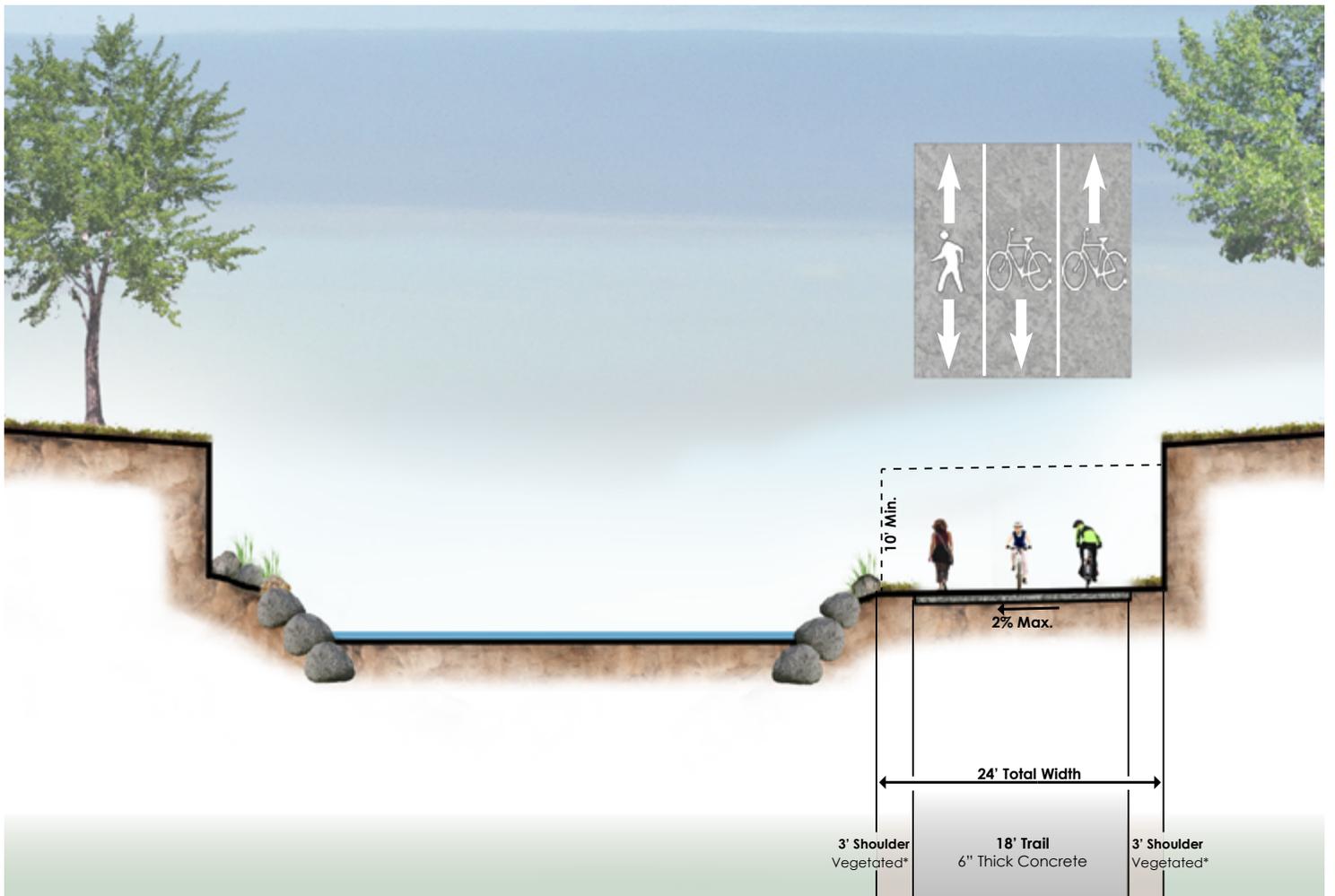


**Regional Trail**  
with Adjacent Crusher Fines Trail





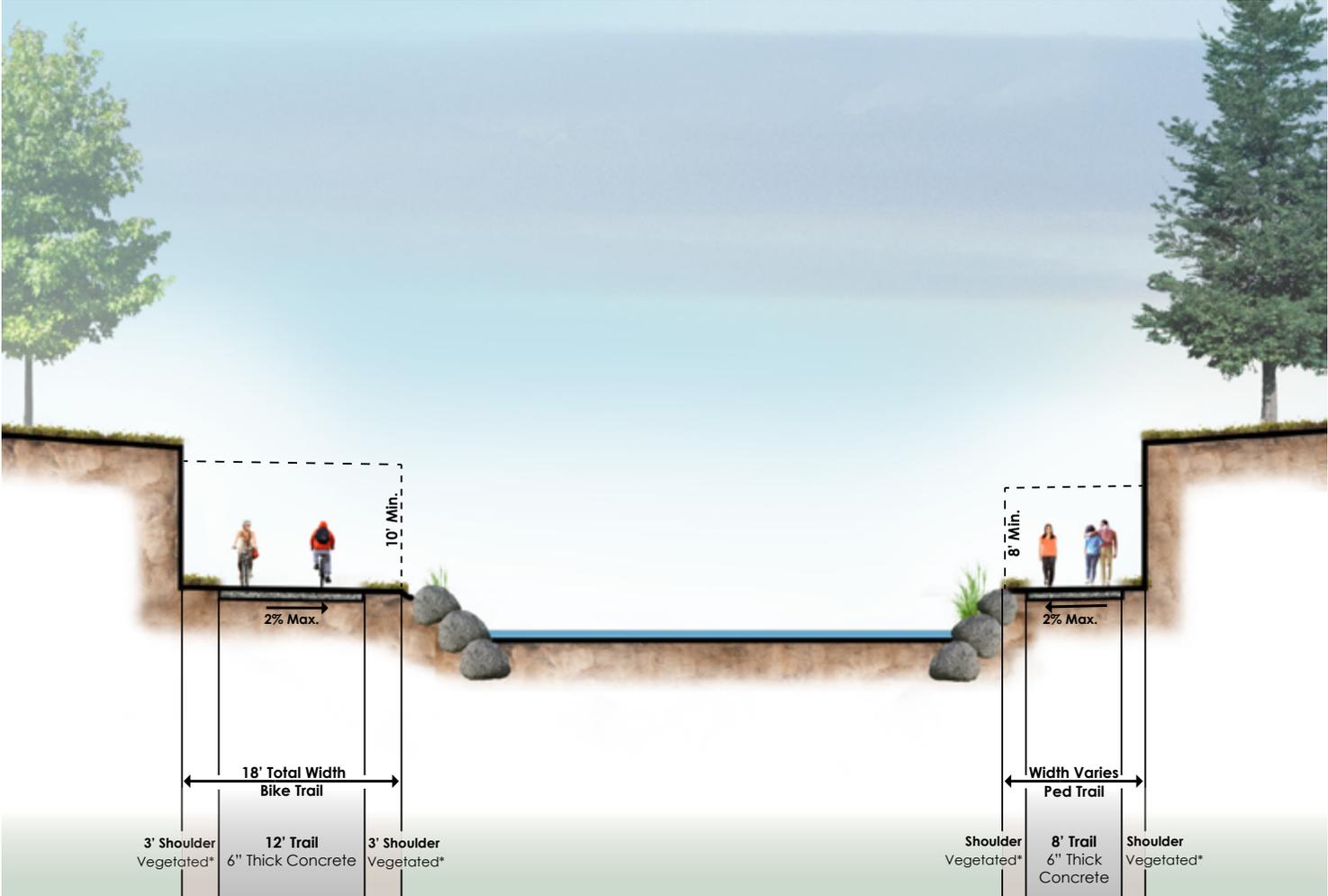
**Regional Trail**  
with Detached Crusher Fines Trail



**Regional Trail**  
Cherry Creek (Downing St. to Colfax Ave.)

\* Concrete rumble strip when adjacent to wall or boulders.

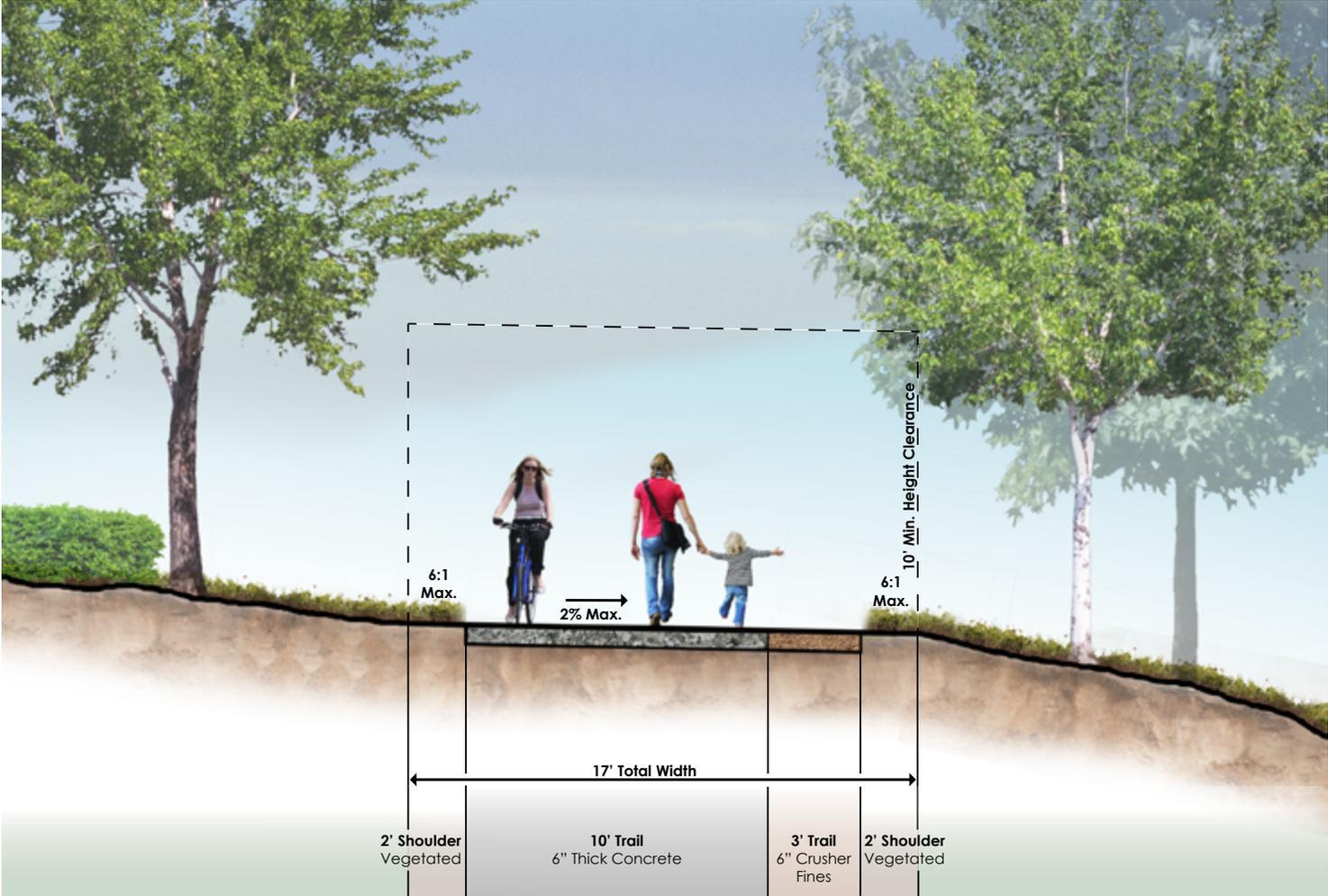




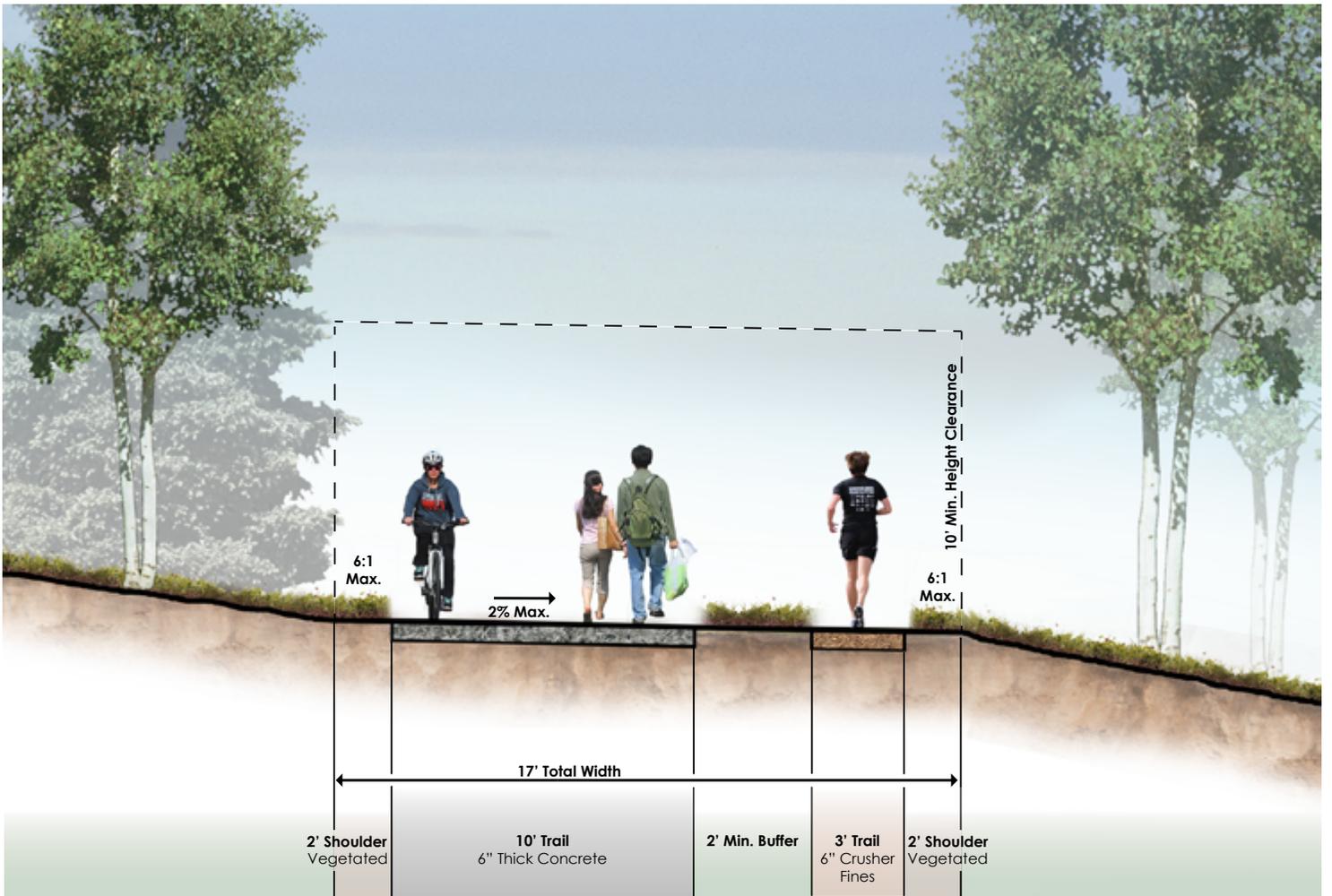
**Regional Trail**  
Cherry Creek (Colfax Ave. to South Platte River)

\* Concrete rumble strip when adjacent to wall or boulders.



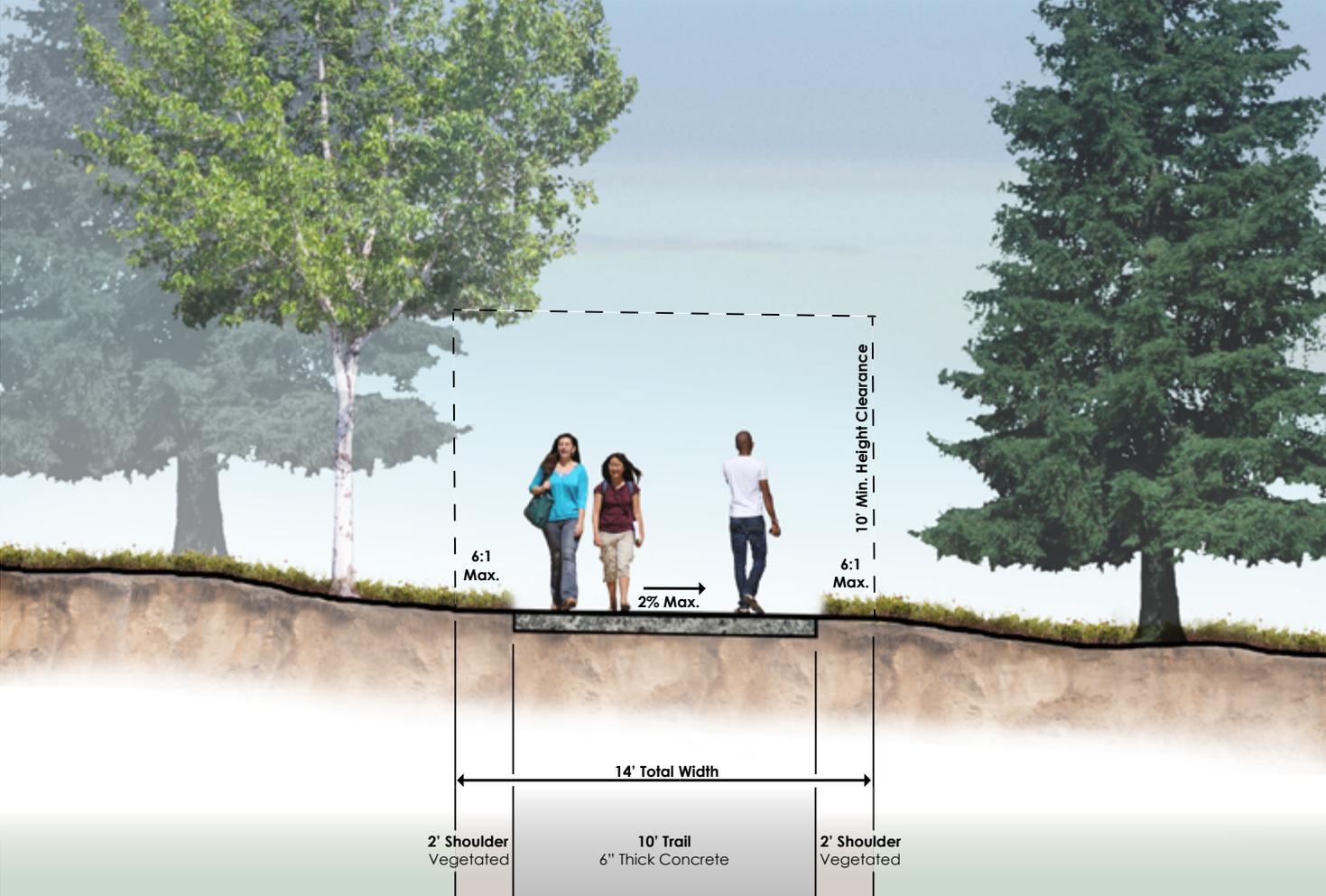


**Collector Trail**  
with Adjacent Crusher Fines Trail

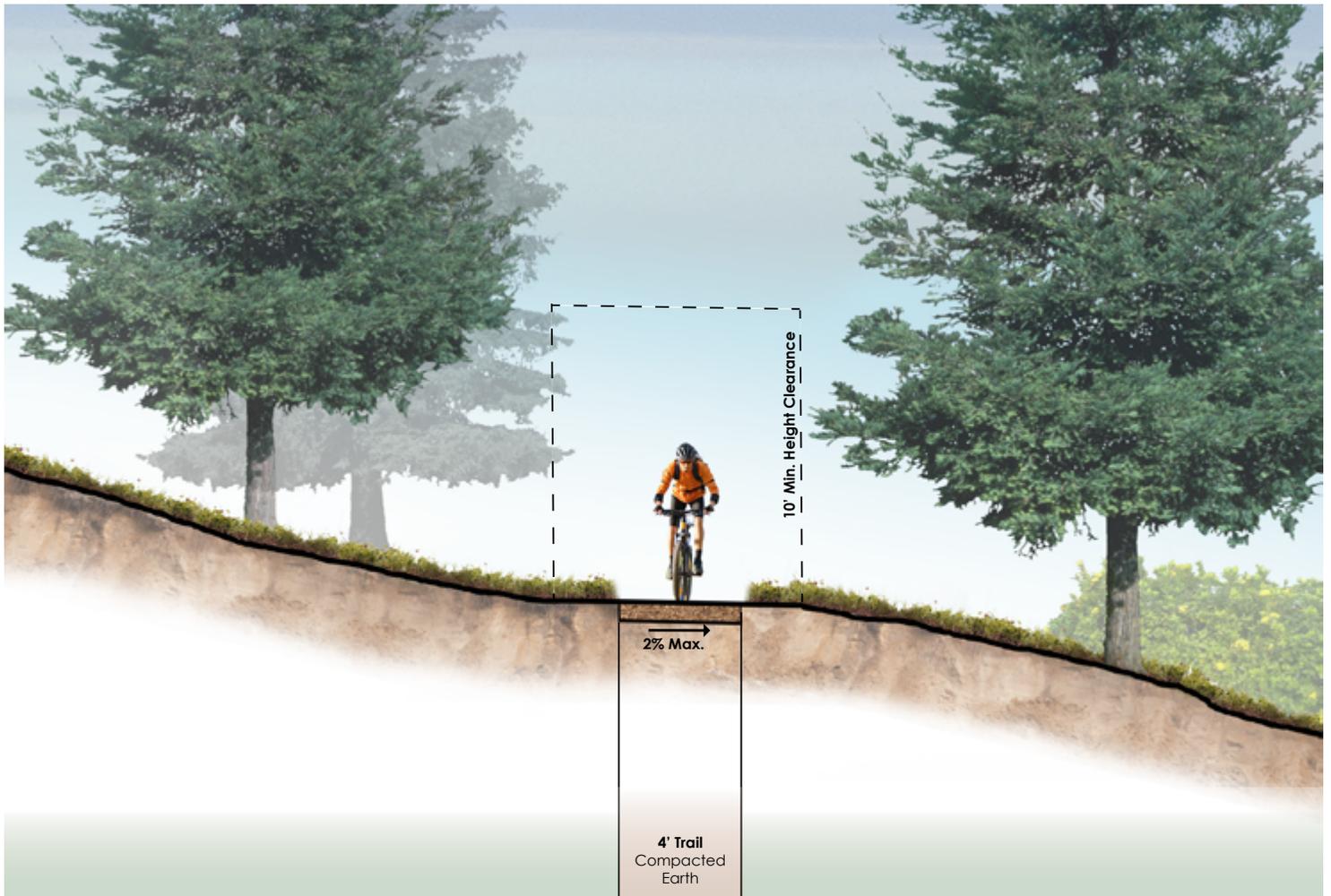


**Collector Trail**  
with Detached Crusher Fines Trail



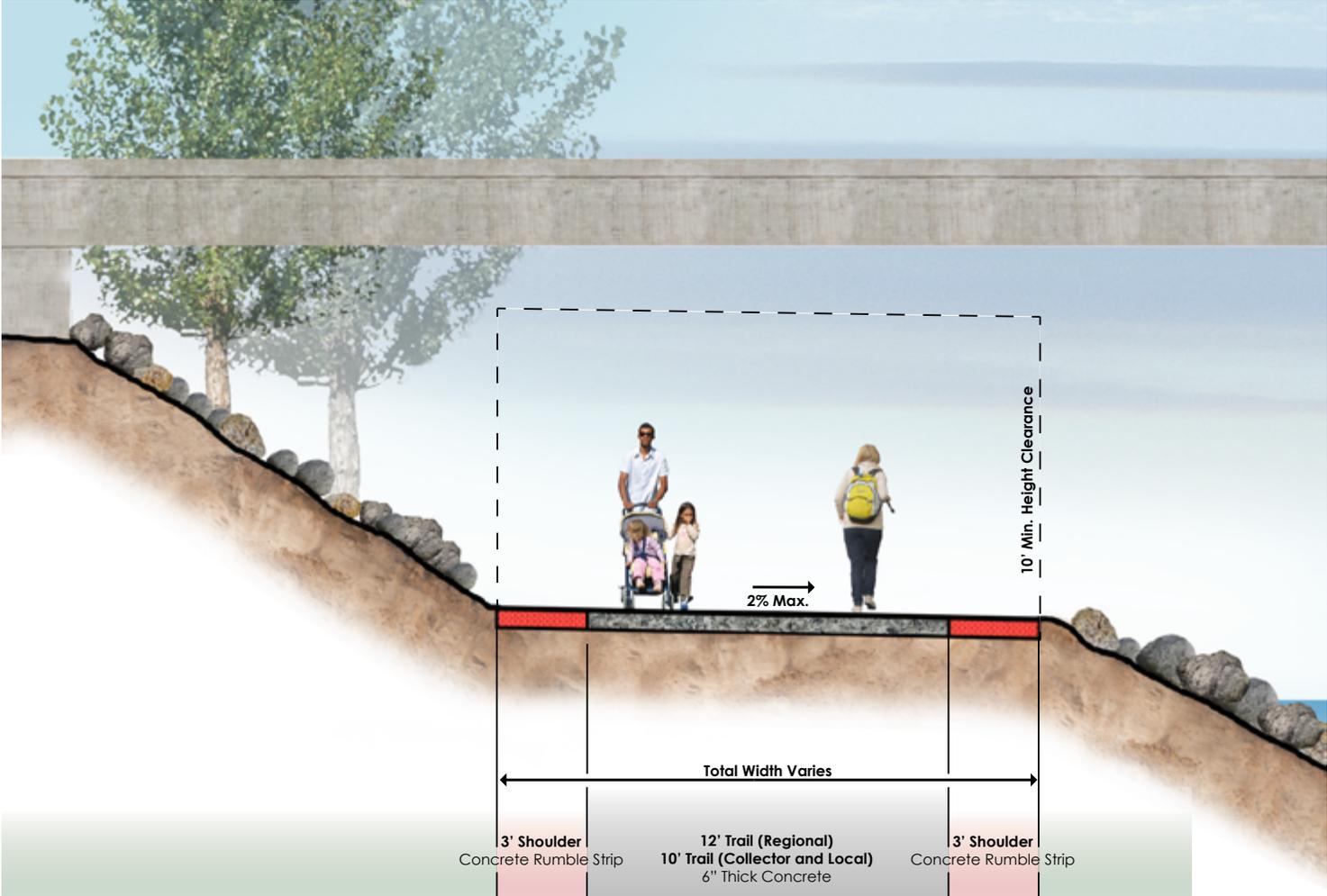


Local Trail

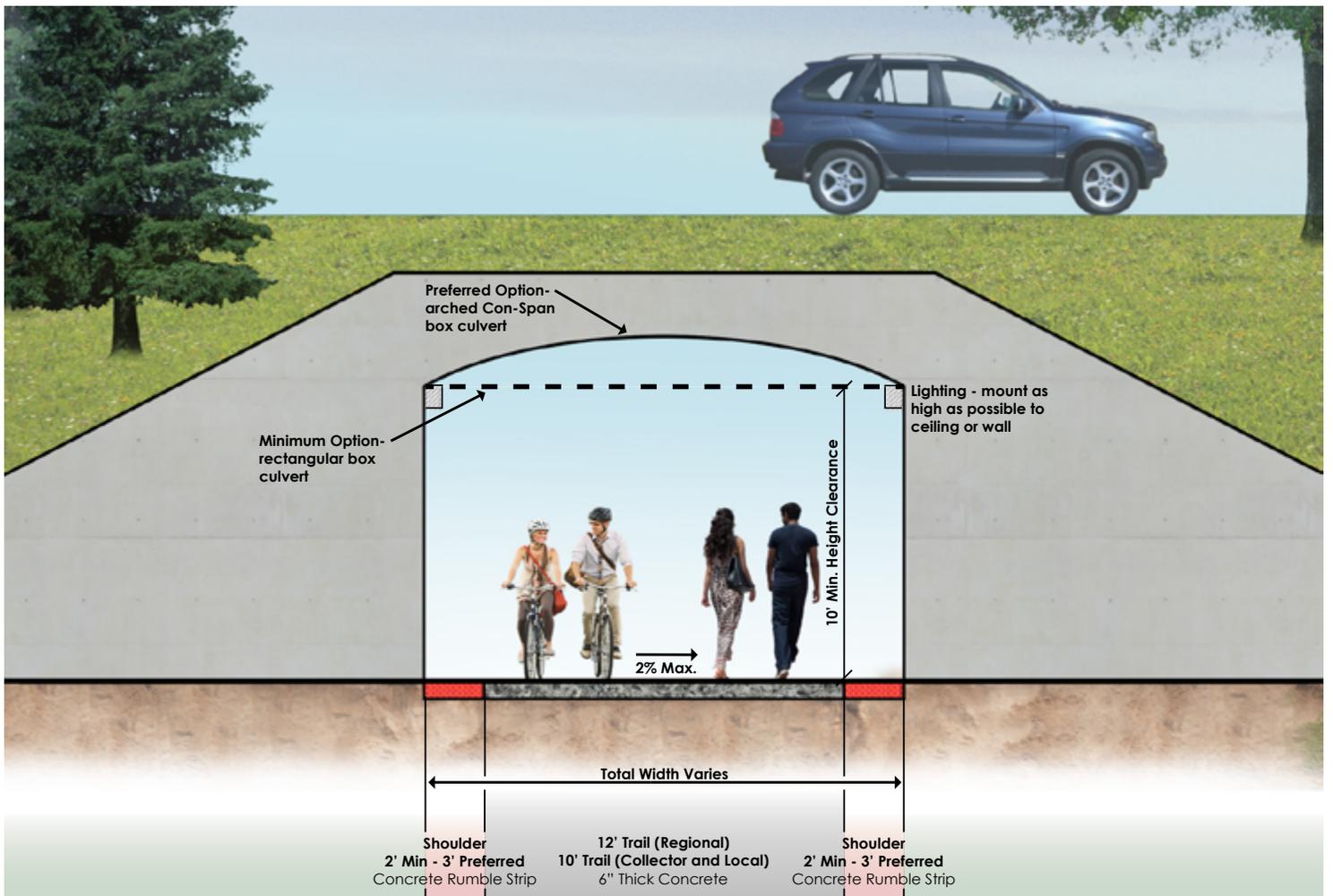


Single Track Trail





Bridge Undercrossing



### Box Culvert Undercrossing







## STREET CROSSING TYPES

Where a Denver trail crosses a street the crossing will be designed so that it is comfortable and safe for users. Grade-separated crossings are established to create a high-quality user experience where users can travel significant distances along a trail without crossing a major street at-grade.

## AT-GRADE CROSSINGS

Denver's *Uncontrolled Pedestrian Crossing Guidelines* (September 2016) establish a framework for evaluating candidate crossing locations and identify appropriate crosswalk treatments and geometric treatments. Where the guidelines' framework identifies a location as being appropriate for a marked crosswalk, three levels of crosswalk treatment are identified based on traffic volume (Average Daily Traffic, or ADT), street operating speed and street configuration (number of lanes and median presence). **Table 2** of the guidelines identifies specific devices for different combinations of traffic volume, operating speed and configuration; however, a general description of these devices is:

**Level A** devices feature crosswalk markings and signing. These are generally appropriate on streets with lower traffic volumes and operating speeds and fewer travel lanes.

**Level B** devices feature markings, signing and Rapid Rectangular Flashing Beacons. These are generally appropriate on streets where markings and signing alone are not sufficient but where Rapid Rectangular Flashing Beacons have demonstrated efficacy in inducing drivers to yield.

**Level C** devices feature markings and either a Pedestrian Hybrid Beacon or a traffic signal. These are generally appropriate on streets with higher traffic volumes and operating speeds and more travel lanes.



**Table 2: Recommended treatment at marked crosswalks**

Roadway Type	Vehicle ADT ≤9,000			Vehicle ADT >9,000 to 12,000			Vehicle ADT >12,000 to 15,000			Vehicle ADT ≥15,000		
	≤30 mph	35 mph	40 mph	≤30 mph	35 mph	40 mph	≤30 mph	35 mph	40 mph	≤30 mph	35 mph	40 mph
Two Lanes	A	A	B	A	A	B	A	A	C	A	B	C
Three lanes	A	A	B	A	B	B	B	B	C	B	C	C
Multilane with raised median	A	A	C	A	B	C	B	B	C	C	C	C
Multilane without raised median	A	B	C	B	B	C	C	C	C	C	C	C

**Notes:**

- A= Level A, B= Level B, C= Level C
- Explore geometric treatments prior to the implementation of the treatment identified in the table.
- RRFBs should be side-mounted and median-mounted where median is present and side-mounted and overhead mounted where median is not present.

Geometric treatments that can be combined with these devices include pedestrian refuge islands, split pedestrian crossover refuge islands, curb extensions and parking prohibition. The guidelines also suggest that staff investigate the feasibility of reducing travel speeds along a street, narrowing or eliminating travel lanes, reducing the street's traffic volume or other traffic calming.

### STOP OR YIELD SIGN ORIENTATION

According to relevant design standards and guidelines, street crossings can be considered intersections between a trail and a street. Generally, at street crossings where intersection control is necessary and the *Uncontrolled Pedestrian Crossing Guidelines* recommend a Level B or Level C device, STOP signs should be positioned on the trail. However, at street crossings where intersection control is necessary and the *Uncontrolled Pedestrian Crossing Guidelines* recommend a Level A device, STOP or YIELD signs may be positioned either on the trail or on the street. The volume of path users relative to the traffic volume on the street may inform whether STOP or YIELD signs should be positioned on the trail or on the street; the *Manual on Uniform Traffic Control Devices* (FHWA, 2009) provides guidance in Section 2B.04 and Section 9B.03 on STOP or YIELD sign orientation.

MUTCD Section 2B.04 provides the following guidance:

*Engineering judgment should be used to establish intersection control. The following factors should be considered:*

- Vehicular, bicycle, and pedestrian traffic volumes on all approaches;*
- Number and angle of approaches;*
- Approach speeds;*
- Sight distance available on each approach; and*
- Reported crash experience.*



Once the decision has been made to control an intersection, the decision regarding the appropriate roadway to control should be based on engineering judgment. In most cases, the roadway carrying the lowest volume of traffic should be controlled. A YIELD or STOP sign should not be installed on the higher volume roadway unless justified by an engineering study.

MUTCD Section 9B.03 provides the following guidance:

When placement of STOP or YIELD signs is considered, priority at a shared-use path/roadway intersection should be assigned with consideration of the following:

- A. Relative speeds of shared-use path and roadway users,
- B. Relative volumes of shared-use path and roadway traffic, and
- C. Relative importance of shared-use path and roadway.

Speed should not be the sole factor used to determine priority, as it is sometimes appropriate to give priority to a high-volume shared-use path crossing a low-volume street, or to a regional shared-use path crossing a minor collector street.

When priority is assigned, the least restrictive control that is appropriate should be placed on the lower priority approaches. STOP signs should not be used where YIELD signs would be acceptable.



## WAYFINDING

Additional wayfinding on Denver's trails system will make it easier to get to the trails system and from the trails system to on-street bikeways and to a variety of regional and neighborhood destinations. Denver recently developed installation guidelines for on-street bikeways. The guidelines identify the different types of wayfinding signs typically used including confirmation signs, turn signs and decision signs. The guidelines also specify the criteria used to identify specific destinations on wayfinding signs. Lastly, the guidelines make suggestions for where signs should be located along bikeways. In many cases, these guidelines can be applied to Denver's trails system to result in a consistent system across both on-street bikeways and trails that is intuitive, useful and clear for users. Wayfinding should be included as a part of trails projects, including new trail segments, widening of existing trail segments, new trail connections, trail connection upgrades and street crossing upgrades. Additionally, it may also be appropriate for the city to develop wayfinding projects for entire trails or major trail segments.

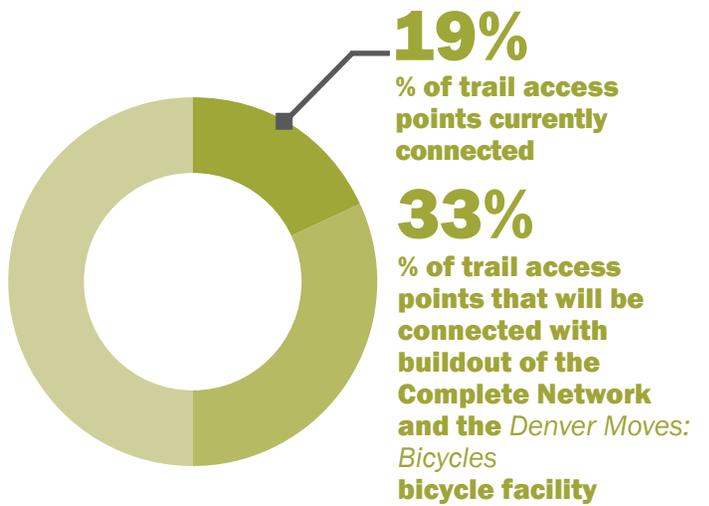




## BENEFITS OF THE COMPLETE NETWORK

Buildout of the Complete Network will achieve the city’s vision for its trails system by meeting the goals derived from community input. Specific benefits of the Complete Network related to each goal are:

- The Complete Network fills in missing segments of trail including gaps along the Weir Gulch Trail, East Harvard Gulch Trail and other trails in the eastern part of the city
- Currently, 19 percent of trail access points are connected to an existing *Denver Moves: Bicycles* bicycle facility. With buildout of the Complete Network and the *Denver Moves: Bicycles* network 33 percent of trail access points will be connected to a *Denver Moves: Bicycles* bicycle facility. Within low-income neighborhoods and areas of health concern, 37 and 35 percent of trail access points, respectively, will be connected to an existing Denver Moves bicycle facility.



- Buildout of the Complete Network and *Denver Moves: Bicycles* network will create a seamless user experience from all parts of the city, including neighborhoods that are distant from the trails system.
- The Complete Network reduces access barriers to nearby destinations, including segments of the South Platte River Trail, Sand Creek Trail and High Line Canal Trail.
- 100 percent of trails will meet the proposed trail design guidelines for regional trails, collector trails and local trails, compared to seven percent in the existing condition.



- Opportunities for a singletrack trail experience throughout the city.



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## TRAILS COSTS



The total cost of completing Denver’s trails network is between \$350 million and \$400 million. Completing the trails network will take many years and will require dedicated funding sources for trails. For illustrative purposes, four representative scenarios are identified to show how long buildout of the trails network will take depending on different funding levels. Completing the trails network will take many years and will need to occur through local investment, grant programs, and other regional or state partnerships.

- \$15 million per year – 24 years to complete.
- \$10 million per year – 37 years to complete.
- \$5 million per year – 73 years to complete.
- \$2.5 million per year – 146 years to complete.

**Table 3** shows the cost of high-priority trails, high-priority connections and crossings and later priority projects.

**TABLE 3. TRAILS COST BREAKDOWN**

<b>PRIORITY TYPE</b>	<b>COST SUBTOTAL</b>
<b>HIGH-PRIORITY TRAILS</b>	<b>\$35 MILLION</b>
<b>HIGH-PRIORITY CONNECTIONS AND CROSSINGS</b>	<b>\$60 MILLION</b>
<b>LATER-PRIORITY SINGLE TRACK AND TRAIL WIDENING</b>	<b>\$225 MILLION</b>
<b>LATER-PRIORITY CONNECTIONS AND CROSSINGS</b>	<b>\$45 MILLION</b>
<b>TOTAL</b>	<b>\$365 MILLION</b>







## TRAILS COSTS

The total cost of completing Denver's trails network is between \$350 million and \$400 million. Completing the trails network will take many years and will require dedicated funding sources for trails.

## IMPLEMENTATION

City staff worked with the community to develop prioritization criteria for projects from the Complete Network. High-priority projects include:

- New hard-surface trails
- Widening of existing trails segments where the trail is much too narrow compared to the proposed design guidelines (>2 feet too narrow)
- New trail connections, trail connection upgrades and crossing upgrades where the trail connects to an existing or proposed *Denver Moves: Bicycles* on-street bikeway
- Crossing upgrades where the trail crosses a major street

All other projects from the Complete Network are later priorities.

**Map 9** shows high-priority trail projects and **Map 10** shows later priority trails projects.

## PRIORITIES FOR SINGLETRACK TRAILS AND SKILLS COURSES

Singletrack trails and skills courses are facility types that do not currently exist on a large scale anywhere on the city's trail system. Denver Parks & Recreation has a small number of mountain bike parks and skills courses located within existing parks, including in Garfield Park and in Ruby Hill Park, as well as plans for a number of small segments of singletrack trails along the South Platte River Trail known as Gateway Trails. These existing facilities are different than those proposed in *Denver Moves: Pedestrians & Trails*. This plan proposes a series of singletrack trail loops throughout the city, meant to allow users a continuous singletrack trail experience along trail corridors, and the ability to build and hone skills. Denver Parks & Recreation must determine how expanding the city's trails system to include this relatively new facility type compares in priority to other possible new facilities. Upon determining that singletrack trails and skills courses are high-priority for funding, a pilot system of singletrack trails and skills courses should be constructed so that the department can learn how to plan, design, operate and maintain these facilities and how the operations and maintenance needs of these facilities are similar to or different from singletrack trails and skills courses within parks. The ideal pilot project would be one that creates a continuous mountain biking or trail running loop with skills courses along the way; one such project is the singletrack loop proposed in the south-east part of the city near Bible Park and Kennedy Golf Course.





## HIGH-PRIORITY PROJECT DESCRIPTIONS

**Map 9** shows high-priority trail projects from the Complete Network. Each project is numbered for easy reference between **Map 9** and the project descriptions below. The projects are not listed in order of importance, and all meet the criteria for high-priority projects as outlined in this Plan. Implementation priority will be influenced by funding availability, adjacent development, political importance, or other factors. More information on high priority projects is available in **Appendix C**.

**1. Clear Creek Trail crossing at 52nd Avenue/ Gray Street** – an at-grade crossing of 52nd Avenue to connect the Clear Creek Trail north of 52nd Avenue to Gray Street so that people using the Clear Creek Trail can seamlessly use 0.2 miles of on-street bikeway to continue along the trail.

**2. 37th Avenue Trail from Yates Street to Wolff Street** – a 330-foot trail along the Rocky Mountain Ditch to better connect residences west of Wolff Street with businesses at the 38th Avenue/Wolff Street intersection.

**3. South Platte River Trail connection at 47th Avenue** – a ramp connection from 47th Avenue to the South Platte River Trail on the south side of 47th Avenue to connect to proposed bike lanes on 47th Avenue.

**4. South Platte River Trail connection at 45th Avenue** – replacement of the existing ramp connection at 45th Avenue. The project will improve safety of the trail crossing through the parking lot, and improve the configuration and comfort for users as it crosses the levy and connects to the South Platte River Trail.

**5. South Platte River Trail connections at 15th Street** – an at-grade crossing of 15th Street to provide a connection between the South Platte River Trail and the on-street bicycle facility along 15th St.

**6. South Platte River Trail connector to City of Cuernavaca Park trails** – a 150-foot segment of new trail south of the South Platte River Trail and on the east side of City of Cuernavaca Park to formalize the connection between the South Platte River Trail and the City of Cuernavaca Park trails.

*Refer to South Platte River Trail study for concept*

**7. South Platte River Trail crossing at Fishback Park** – a bridge crossing of the South Platte River west of Speer Boulevard that connects the Cherry Creek Trail via Little Raven Street to Water Street without going through Confluence Park. Multiple possible bridge crossing locations and types (bicycle/ pedestrian-only vs. all modes) are being considered as a part of the Central Platte Valley Auraria District Downtown Area Plan Amendment; at minimum, at least one of the bridges should address this identified need.

*Refer to South Platte River Trail study for concept*



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**8. Broadway Station Trail from the South Platte River Trail to Broadway** – a 1,730-foot trail from the South Platte River Trail at Vanderbilt Park, over the South Platte River (bridge required), through the I-25/Broadway Station Area, over the Consolidated Main Line (bridge or underpass required) and connecting to Broadway. This trail provides an important connectivity between the South Platte River, Broadway Station, and Washington Park.

**9. South Platte River Trail connection at Jewell Avenue** – a bridge connection over the South Platte River connecting the South Platte River Trail on the east side to Jewell Avenue on the west side. Refer to South Platte River Trail study for concept

**10. Lakewood Dry Gulch Trail crossing at Perry Street** – an at-grade crossing of Perry Street to connect to a proposed neighborhood bikeway on Perry Street.

**11. Weir Gulch Trail crossing at 8th Avenue/ Federal Boulevard** – a grade-separated crossing of Federal Boulevard and 8th Avenue so that Weir Gulch can connect directly to the South Platte River Trail. One continuous bridge crossing both roadways is likely the most feasible; however, an undercrossing should also be considered as part of an alternatives analysis and feasibility study.

**12. Weir Gulch Trail crossing at 1st Avenue** – an at-grade crossing of 1st Avenue to connect to proposed buffered bike lanes on 1st Avenue.

**13. Weir Gulch Trail crossing at Bayaud Avenue** – an at-grade crossing of Bayaud Avenue to connect to proposed bike lanes on Bayaud Avenue and a proposed neighborhood bikeway on Stuart Street.

**14. Weir Gulch Trail at Alameda Avenue** – a grade-separated crossing of Alameda Avenue to pro-

vide a high-quality trail user experience rather than having to cross Alameda Avenue.

**15. Westwood Trail** – a 1.8-mile combined trail and on-street bikeway from Sheridan Boulevard to Zuni Street generally following an overhead power line easement. The Westwood Neighborhood Plan identifies elements of this trail and area residents have a vision for integrating this trail into a larger recreational loop. Generally, the Westwood Trail would be an on-street bikeway from Sheridan Boulevard to Perry Street, a trail (already existing) from Perry Street to Meade Street, an on-street bikeway from Meade Street to Lowell Boulevard, and a trail from Lowell Boulevard to Mississippi Avenue.

**16. West Harvard Gulch Trail crossing at Federal Boulevard** – an at-grade crossing of Federal Boulevard to connect neighborhoods west of Federal Boulevard to the West Harvard Gulch Trail. Further study of this project should consider relocating the existing pedestrian signal north of Harvard Avenue to the south side of Harvard Avenue or to Vassar Avenue.

**17. Bear Creek Trail connection at Golden Way** – a bridge connection over Bear Creek connecting the Bear Creek Trail on the south side to the Dartmouth Avenue/Golden Way intersection on the north side, providing improved connectivity to Henry Middle School and Traylor Elementary School.

**18. Bear Creek Park trail from Kenyon Avenue to Raleigh Street** – a 3,440-foot trail through Bear Creek Park connecting Kenyon Avenue near its intersection with Sheridan Avenue to the Raleigh Street underpass of US 285. This requires an improved bridge crossing over Bear Creek.



**19. Marston Trail** – a 3.4-mile (1.6-miles in Denver) combined trail and on-street bikeway from Garrison Street to the Bear Creek Trail at S. Pierce Street. Generally, the Marston Trail would be a trail from Garrison Street to Quincy Avenue and a shared-use sidewalk along Quincy Avenue to Wadsworth Boulevard. From Wadsworth Boulevard, the trail would likely be a combination of shared-use roadway and trail to the Bear Creek Trail. This trail will require coordination with the City of Lakewood.

**20. Wagon Trail from Grand Avenue to Belleview Avenue** – a 470-foot trail to connect the Wagon Trail to Belleview Avenue.

**21. Marston Lake Trail** – a 1,970-foot trail along the south side of Marston Lake that will connect portions of the Marston neighborhood to Pinyon Drive in Bow Mar, and ultimately to the Bear Creek Trail via the shared-use roadway along Sheridan Boulevard. The trail will require coordination with the Town of Bow Mar.

**22. East Harvard Gulch Trail crossing at University Boulevard** – an at-grade crossing of University Boulevard to provide a high-quality trail user experience rather than having to travel 850 feet out-of-direction to comfortably cross University Boulevard at Yale Avenue.

**23. East Harvard Gulch Trail from Jackson Street to Colorado Boulevard** – a 300-foot trail to connect from Jackson Street to Colorado Boulevard via an existing pathway through the Schlessman Family YMCA’s parking lot.

**24. High Line Canal Trail crossing at Yale Avenue (west of Holly Street)** – a grade-separated crossing of Yale Avenue to provide a high-quality trail user experience rather than having to cross Yale Avenue; this project is included in the 2017 General Obligation Bond.

**25. High Line Canal Trail crossing at Holly Street** – a grade-separated crossing of Holly Street to provide a high-quality trail user experience rather than having to cross Holly Street.

**26. High Line Canal Trail crossing at Yale Avenue (west side of James A. Bible Park)** – a grade-separated crossing of Yale Avenue to provide a high-quality trail user experience rather than having to cross Yale Avenue.

**27. High Line Canal Trail crossing at Yale Avenue (east side of James A. Bible Park)** – a grade-separated crossing of Yale Avenue to provide a high-quality trail user experience rather than having to cross Yale Avenue.



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### **28. High Line Canal Trail crossing at Quebec**

**Street** – a grade-separated crossing of Quebec Street to provide a high-quality trail user experience rather than having to cross Quebec Street.

### **29. Cherry Creek Trail connection at Yosemite**

**Street** – a street connection to Yosemite Street to connect to the existing shared roadway on Yosemite Street.

### **30. High Line Canal Trail crossing at Dayton**

**Street** – an at-grade crossing of Dayton Street to provide a high-quality trail user experience by increasing user comfort in crossing Dayton Street.

### **31. Oneida Street on-street bikeways connection**

– replacement of the existing staircase along Oneida Street north of Leetsdale Drive with either a staircase with a bicycle channel or a ramp and switchback to the east of the existing staircase (requires property owner coordination).

### **32. Goldsmith Gulch Trail crossing at I-225**

– reconfiguration of the I-225/Tamarac Street/DTC Boulevard interchange to increase user comfort crossing the southbound off-ramp and northbound on-ramp; reconfiguration options include modifying free right-turn movements to encourage slower vehicle speeds, increase yield compliance at the crosswalks or require drivers to stop.

### **33. Kennedy Soccer Complex trail**

– 2,900-foot trail on the west side of Kennedy Soccer Complex to connect the Hampden Heights neighborhood to the Dayton Station and the Cherry Creek Trail south (requires collaboration with the City of Aurora).

### **34. Westerly Creek Trail extension at Lowry**

**Sports Complex** – a 1.4-mile trail on the west side of Westerly Creek Dam Pond connecting Alameda Avenue at Xenia Street to the Westerly Creek Trail at Lowry Boulevard.

### **35. Westerly Creek Trail connection to Verbena**

**Park** – a 400-foot shared-use sidewalk on the north side of 11th Avenue from Uinta Way to Verbena Park.

### **36. Sand Creek Trail connector to Airlawn Road**

– a 1,520-foot trail that will connect the Sand Creek Trail to Airlawn Road near 41st Avenue. This is a critical connector trail providing connectivity to Denver's trail system for Park Hill and surrounding neighborhoods.

### **37. Sand Creek Trail connection at Smith Road**

– a ramp connection from the Sand Creek Trail to Smith Road.

### **38. Northfield Trail**

– a 1.1-mile trail from 56th Avenue to the north city limits.

### **39. Peña Trail from Bolling Drive to Green Valley**

**Ranch Boulevard** – a 1,650-foot trail from Bolling Drive to Green Valley Ranch Boulevard.

### **40. Peña Trail from Green Valley Ranch Boulevard to 56th Avenue**

– a 1.0-mile trail from Green Valley Ranch Boulevard to 56th Avenue.

### **41. Derby Lateral Trail from Peña Trail to 44th**

**Avenue at Telluride Court** – a 1.2-mile trail from the Peña Trail to 44th Avenue at Telluride Court. The trail will cross under Peña Boulevard on the north side of Green Valley Ranch Boulevard, cross to the south side of Green Valley Ranch Boulevard at the northbound ramps intersection, cross under the RTD A Line at Derby Lateral and follow Derby Lateral to the Denver city limits near Telluride Street where it will connect with a City of Aurora trail.

### **42. First Creek Trail from 39th Avenue to High**

**Line Canal Trail** – a 3,370-foot trail from 39th Avenue to the High Line Canal Trail.



**43. First Creek Trail from Green Valley Ranch Boulevard to the High Line Canal Trail** – a 750-foot trail from Green Valley Ranch Boulevard to the High Line Canal Trail (requires coordination with the Town Center Metropolitan District).

**44. High Line Canal Trail from Maxwell Place to 56th Avenue** – a 1,340-foot trail from the Maxwell Place to 56th Avenue.

**45. First Creek Trail crossing of Green Valley Ranch Boulevard (east of Malaya Street)** – an at-grade crossing of Green Valley Ranch Boulevard.

**46. High Line Canal Trail crossing of 56th Avenue** – a grade-separated crossing of 56th Avenue.

**47. Second Creek Trail from City limits near 66th Avenue to north City limits** – a 2.4-mile trail from the city limits near 66th Avenue to the north City limits near 18000 E. 81st Avenue. Starting at the city limits near 66th Avenue, the trail follows Second Creek to the RTD A Line, crosses underneath the RTD A Line at Tower Road and follows Second Creek underneath Peña Boulevard to the north City limits.

**48. Peña Trail from the First Creek Trail to Denver International Airport** – an 8.5-mile trail from the First Creek Trail west of Peña Boulevard to Denver International Airport.

**49. Cherry Creek Trail connections at Lawrence Street and Arapahoe Street** – improvements to the sidewalk between Speer Boulevard and Cherry Creek to create a shared-use sidewalk that provides access to the existing ramps at Cherry Creek Trail ramps at Lawrence Street and between Arapahoe Street and Champa Street.

**50. Cherry Creek Trail connection at Champa Street** – a ramp connection at Champa Street to connect to proposed buffered bike lanes. The existing ramp headed toward Arapahoe Street should remain.

**51. Cherry Creek Trail connection at 14th Avenue** – a ramp connection at 14th Avenue to connect to existing protected bike lanes.

**52. Cherry Creek Trail connection at 11th Avenue** – a ramp connection at 11th Avenue to connect to existing bike lanes.

**53. Cherry Creek Trail connections (two) at Bannock Street** – a pair of ramp connections at Bannock Street both north and south of Speer Boulevard to make continuous north-south travel on Bannock Street possible without biking on or along Speer Boulevard.

**54. Cherry Creek Trail connection at Broadway** – a ramp connection at Broadway to connect to the proposed protected bike lanes.

**55. Cherry Creek Trail connections at Washington Street and Clarkson Street** – a ramp connection between Washington Street and Clarkson Street to connect to the proposed bike lanes on these streets.



### **56. Cherry Creek Trail connection at Ogden**

**Street** – an at-grade crossing of Speer Boulevard to connect the Cherry Creek Trail to the proposed neighborhood bikeway on Ogden Street (requires a shared-use sidewalk from Corona Street to Ogden Street).

### **57. Cherry Creek Trail crossing at 1st Avenue/**

**Speer Boulevard** – modifications to the 1st Avenue/Speer Boulevard/Downing Street intersection to increase comfort for people riding northbound on the shared-use sidewalk east of Downing Street connecting to the Cherry Creek Trail.



## High Priority Bikeways

In many cases, high-priority trails projects directly connect to proposed *Denver Moves: Bicycles* facilities. *Denver Moves: Bicycles* identifies existing bikeways as well as three implementation phases. The following shows which high-priority trails projects connect to existing, Phase 1 or Phase 2 *Denver Moves: Bicycles* facilities.

### Existing

- 12. Weir Gulch Trail crossing at 1st Avenue
- 15. Portions of the Westwood Trail
- 18. Bear Creek Park trail from Kenyon Avenue to Raleigh Street
- 29. Cherry Creek Trail connection at Yosemite Street
- 31. Oneida Street on-street bikeways connection
- 34. Westerly Creek Trail extension at Lowry Sports Complex
- 49. Cherry Creek Trail connections at Lawrence Street and Arapahoe Street
- 50. Cherry Creek Trail connection at Champa Street
- 51. Cherry Creek Trail connection at 14th Avenue
- 52. Cherry Creek Trail connection at 11th Avenue
- 53. Cherry Creek Trail connections at Bannock Street
- 55. Cherry Creek Trail connections at Washington Street and Clarkson Street

### Phase 1

- 15. Portions of the Westwood Trail
- 35. Westerly Creek Trail connection to Verbena Park
- 54. Cherry Creek Trail connection at Broadway
- 56. Cherry Creek Trail connection at Ogden Street

### Phase 2

- 4. South Platte River Trail connection at 45th Avenue
- 10. Lakewood Dry Gulch Trail crossing at Perry Street
- 11. Weir Gulch Trail crossing at 8th Avenue/Federal Boulevard
- 13. Weir Gulch Trail crossing at Bayaud Avenue
- 15. Portions of the Westwood Trail
- 16. West Harvard Gulch Trail crossing at Federal Boulevard
- 19. Marston Trail
- 24. High Line Canal Trail crossing at Yale Avenue (west of Holly Street)
- 26. High Line Canal Trail crossing at Yale Avenue (west side of James A. Bible Park)
- 27. High Line Canal Trail crossing at Yale Avenue (east side of James A. Bible Park)
- 37. Sand Creek Trail connection at Smith Road
- 39 & 40. Peña Trail from Bolling Drive to 56th Avenue
- 41. Derby Lateral Trail from Peña Trail to 44th Avenue at Telluride Court
- 43 & 45. First Creek Trail from Green Valley Ranch Boulevard to the High Line Canal Trail and First Creek Trail crossing of Green Valley Ranch Boulevard (east of Malaya Street)
- 44. High Line Canal Trail from Maxwell Place to 56th Avenue
- 57. Cherry Creek Trail crossing at 1st Avenue/Speer Boulevard



## POLICIES & PROGRAMS

Investments in trails infrastructure projects are critical for the city to achieve its vision for its trails system. However, a range of policy and program actions are also necessary for the city to achieve its vision. These policy and program actions go beyond the scope of *Denver Moves: Pedestrians & Trails*; however, completing these actions is valuable for improving the quality of trail design, operations and maintenance, for collecting and applying important data to trails projects, for attracting more funding, for supporting respectful user behavior and for planning for specific needs. *Denver Moves: Pedestrians & Trails* has several trails-related policy and program actions, some of which are identified as high-priority based on Task Force feedback.

### TRAIL DESIGN & OPERATION

#### 1. Lighting

Develop and adopt guidelines for the installation of lighting along off-street trails. These guidelines should address under which conditions trails should be lighted, levels of lighting to be met, and types of light fixtures to be used along trails.

High-priority

#### 2. Amenities

Develop and adopt guidelines for amenities along Denver's trail system. At a minimum, guidelines should address trailheads, restrooms, repair/air stations, drinking fountains/bottle fillers, and rest areas. The guidelines should address frequency of the various types of amenities and design guidelines for each.

High-priority

#### 3. Access points

Develop and adopt guidelines for access points to the trail system. These guidelines should address access points located on both public and private property, and conditions under which each is allowed.

High-priority

#### 4. Place making

Develop and adopt guidelines for placemaking features along the trail system. The guidelines should be flexible enough to allow designers freedom to design unique elements, but also provide standards with regards to specific safety requirements for trails.

#### 5. Signage

Develop and adopt guidelines for signage along the off-street trail system. The guidelines should address wayfinding, regulatory, and interpretive signage.



<p>6. Regional coordination vs. Denver standard for design features</p> <p>Develop and adopt guidelines for design coordination with other trail providing agencies. There have been efforts in the past to coordinate among multiple agencies along specific trail corridors to develop signs, site furnishings, and other design features that are unique and specific to the trail corridor rather than have each agency utilize their standard in their portion of the trail. These guidelines need to consider the regional importance of some of the trails in Denver.</p>	
<p>7. Reference to/adoption of other design guidelines</p> <p>There are currently national design standards and guidelines that may be applicable to various design elements of trails. These include the American’s with Disabilities Act, the American Association of Highway and Transportation Officials Guidelines for the Design of Bicycle Facilities, and the Universal Building Code. The city should make clear how, or if, these other standards and guidelines influence, or are referenced in the city’s design guidelines.</p>	
<p>8. Trail design</p> <p>Develop and adopt guidelines for the physical design of trails. At a minimum, the guidelines should address design speed, horizontal and vertical curves, site distance, construction materials, recovery zones, and safety elements such as railings. Some or all of these items could reference other guidelines as discussed above.</p>	<p>High-priority</p>
<p>9. Grade-separated Street Crossings</p> <p>Develop and adopt guidelines for determining whether street crossings should be at-grade vs. grade separated.</p>	<p>High-priority</p>
<p>10. Detour practices</p> <p>Develop and adopt guidelines for when detours shall be used, as well as guidelines for physical elements of detour routes. At a minimum, these guidelines should address acceptable surface materials, barriers, signage, use of on-street facilities, and maintenance routines.</p>	<p>High-priority</p>



## TRAIL OPERATIONS AND MAINTENANCE

### 11. Trails maintenance

Develop and adopt a maintenance plan for the trail system including standard maintenance practices and frequencies of operations.

High-priority

### 12. Trails maintenance responsibilities

Clarify and standardize responsibilities for various maintenance operation between the City Wide Trails Group and the various maintenance districts.

High-priority

### 13. Adopt-a-Trail program

Determine the feasibility/need/design to implement an adopt-a-trail program.

### 14. Organized events

Develop and adopt guidelines for the use of trails for organized events (running or cycling races, charity walks, festivals, etc.). At a minimum, these guidelines should address whether trails can be closed to the public, acceptable lengths of time for use of facilities, maintenance and clean-up of facilities by the event organizer after the event, signage (prior to and during the event), and liability.

## TRAIL OPERATIONS AND MAINTENANCE

### 15. Trail counters

Determine specific objectives for collecting trail user count data. Consider developing a list of locations to collect user count data, a regular schedule for rotating the counters, and a standard duration for placement of counters at various locations.

High-priority

### 16. Street crossing database

Develop a database of all street crossings in the trail system, categorized by grade-separated, controlled at-grade, and uncontrolled at-grade.



**FUNDING AND IMPLEMENTATION**

17. Partnerships

Identify and pursue opportunities to partner with other organizations to help fund trail projects. These could include public/private partnerships, or partnerships with other agencies or non-profits.

High-priority

**EDUCATION, ENCOURAGEMENT AND ENFORCEMENT**

19. Trail behavior and user conflicts

Develop education and encouragement programs specially aimed at reducing behaviors that result in user conflicts. If necessary to complement education and encouragement programs, develop an enforcement program.

20. Allowable vehicle types

Evaluate existing ordinances regarding types of vehicles allowed on trails (e-bikes, motor assist vehicles, Segway, scooter, etc.).

21. Enforcement needs assessment

Review current enforcement capabilities and identify additional needs.

High-priority

22. Rules and regulations

Review rules and regulations and update as necessary on an annual basis.

High-priority



## **FUTURE PLANNING NEEDS**

### 23. Citywide needs

Identify and fund further planning studies regarding trails in Denver. These could include: mountain bike/gateway trails/single-track trail system planning, citywide at-grade crossing study, lower Cherry Creek corridor).

High-priority

### 24. Trail-oriented development

Develop a planning study to encourage and provide guidelines for trail oriented development. Explore opportunities to acknowledge and embrace trails and trail users in new developments.



## REGIONAL PARTNERS

In many cases, implementing some of the projects recommended in this plan will require coordination with regional partners. Some likely partners with whom coordination may be necessary are:

**Bear Creek Trail** – City of Lakewood

**Clear Creek Trail** – Adams County, City of Wheat Ridge

**Goldsmith Gulch Trail** – City of Greenwood Village

**Highline Canal Trail** – Arapahoe County, City of Aurora and the High Line Canal Conservancy

**Lakewood Gulch Trail** – City of Lakewood

**Northfield Trail** – City of Commerce City

**Sand Creek Trail** – City of Commerce City and City of Aurora

**Sanderson Gulch Trail** – City of Lakewood

**Wagon Trail/Marston Trail** – Jefferson County, City of Lakewood and Foothills Parks & Recreation District

**Weir Gulch Trail** – City of Lakewood

**West Harvard Gulch Trail** – City of Englewood



## MONITORING PROGRESS

Achieving Denver’s vision for a world-class trail system will take time. While the trail system builds out, the city can monitor its progress annually so that the Denver community, decision-makers and City staff understand the progress that the city is making towards its vision.



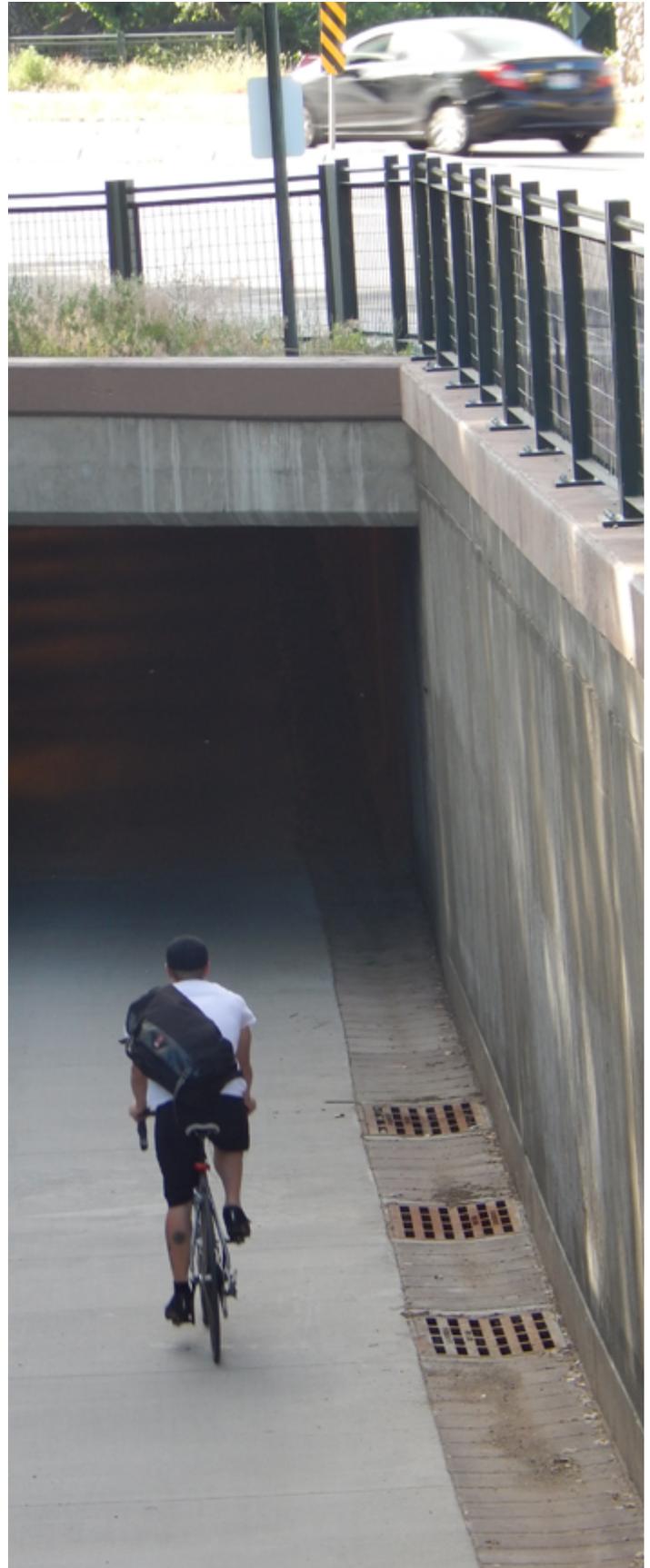
At minimum, Denver Parks & Recreation will prepare a brief annual report of projects completed along the trail system. The annual report will identify:

- Capital (not maintenance) projects completed along the trail system and whether or not they were identified by *Denver Moves: Pedestrians & Trails*; for projects not identified by *Denver Moves: Pedestrians & Trails*, provide a description of why the project was identified and selected.
- For each project:
  - A brief description of how the project helps achieve the goals of *Denver Moves: Pedestrians & Trails* (Connectivity, Destination Access, Equity, Health and Safety); for example:
    - Which projects filled in missing segments of trail, including gaps?
    - Which projects connected to an existing or proposed *Denver Moves: Bicycles* on-street bikeway?
    - Which projects connected to an existing or proposed *Denver Moves: Bicycles* on-street bikeway that improved trail system connectivity for neighborhoods that are distant from the trails system?
    - Which projects connected the trail system to nearby destinations?
    - Which projects brought the trail’s design up to the proposed trail design standards?
  - Identify the funding source or sources used.
- Policy and program actions achieved



Every two years as a part of this annual report Denver Parks & Recreation will provide some updated performance measure status per the Goals & Performance Measures identified by *Denver Moves: Pedestrians & Trails*. Specifically, performance measures to be included are:

- Percent of intersections between off-street trails and Denver Moves on-street bikeways that provide a connection between the two.
- Percent of trails that meet the proposed trail design guidelines.
- Percent of new trail constructed as recommended by this plan.
- Number of street crossings that meet Denver’s *Uncontrolled Pedestrian Crossing Guidelines*.
- If available, updated trail count data at the segments counted for the Existing Conditions Report (ideally this would include all segments, but this should at least include busy trails segments or trail segments nearby to major trail projects).



## EDUCATION AND OUTREACH

Through the development of *Denver Moves: Pedestrians & Trails*, city staff and the project team identified candidate ways that the Denver Moves' brand could transcend beyond transportation planning to also serve as a brand that promotes a culture of safety and sharing of transportation resources. If it occurs, and extension of the Denver Moves brand will occur after the finalization of *Denver Moves: Pedestrians & Trails*; however, *Denver Moves: Pedestrians & Trails* identified top themes that could be incorporated into signage or a marketing campaign:

■ For multimodal transportation, including walking:

- Slowing down to create a safe street for all users
- Avoiding distractions while driving
- Complying with traffic laws
- Sharing the street with all users
- Encouraging multimodal transportation, including walking, biking and transit

■ For trails:

- Keeping trails clean
- Sharing the trail
- Being courteous to other trail users (trail etiquette, etc.)
- Managing pets on the trail, in particular dog leashes
- Yielding the most vulnerable users; for instance, bicyclists yielding to pedestrians

## INTEGRATING WITH DENVER MOVES: BICYCLES AND DENVER MOVES: TRANSIT

### PLAN DEVELOPMENT

Development of *Denver Moves: Pedestrians & Trails* was coordinated with both the existing *Denver Moves: Bicycles* network and key components of *Denver Moves: Transit* that were also under development in 2016 and 2017. Specifically, coordination occurred in the following areas:

- **Bicycles** – *Denver Moves: Pedestrians & Trails* coordinated locations of trail connections and crossings with proposed on-street bikeways from *Denver Moves: Bicycles*. In some cases, recommendations were made to relocate or revise recommended *Denver Moves: Bicycles* facilities to better connect the trails system to the on-street bikeway system and key destinations. Public Works intends to later formalize these updates in *Denver Moves: Bicycles*.

- **Transit** – *Denver Moves: Pedestrians & Trails* gives a high priority to many transit access projects. Specifically, Tier 2 and 3 sidewalk projects are those that serve existing high-frequency transit corridors (many of these corridors are also proposed for transit investments by *Denver Moves: Transit*). And, Tier 4 includes sidewalk projects that serve other remaining transit corridors.

### MOVING FORWARD

The Denver Moves program recognizes that transportation functions as a system. Many Denverites use multiple modes of transportation throughout their day. Most transit passengers also walk, bike or drive for a portion of their trip. And, most Denver streets serve multiple modes of transportation. As such, implementation of any project from a Denver Moves plan should consider what other projects may be appropriate to include with it. For instance:

- Implementing investments on a *Denver Moves: Transit* corridor, planners and engineers should also identify possible priorities from *Denver Moves: Pedestrians & Trails* (such as high-priority sidewalks and at-grade crossings) and *Denver Moves: Bicycles* (such as on-street bikeways along or across the corridor) that could be implemented with the transit improvements.
- Implementing on-street bikeways from *Denver Moves: Bicycles*, planners and engineers should also identify possible high-priority sidewalks, at-grade crossings and trail connectivity projects that could be implemented, especially where the *Denver Moves: Bicycles* project requires geometric changes (concrete or asphalt construction) to the street.





## INTEGRATING WITH THE NEIGHBORHOOD PLANNING INITIATIVE

### PLAN DEVELOPMENT

In 2016 the Department of Community Planning and Development launched the *Neighborhood Planning Initiative*, a long-term commitment to develop an area plan for all parts of the city over the next 10 to 14 years. To accelerate plan development within 10 to 14 years, neighborhoods with similar characteristics were grouped into planning areas.

Transportation and connectivity are key concepts in each neighborhood plan and transportation is likely to play a role in Transformative Projects, a key concept of *Neighborhood Planning Initiative*. Recommendations from *Denver Moves: Pedestrians & Trails* can be further

developed and refined through *Neighborhood Planning Initiative* (NPI). Specifically:

- For sidewalks, NPI can identify neighborhood-specific priorities that are not well-captured by *Denver Moves: Pedestrians & Trails*' tiers, in particular, locations with missing sidewalks where a lot of people are already walking.
- For at-grade crossings, NPI can complete relevant study per the *Uncontrolled Pedestrian Crossing Guidelines* to identify locations that meet the guidelines' criteria and what devices are appropriate at those locations.
- For trails, NPI can identify planning area-specific priorities for new trails or for connections and crossings, in particular those that connect to *Denver Moves: Bicycles* on-street bikeways or those that improve access to key planning area destinations.

# About Denveright

Denveright is a set of community-driven plans that shape Denver's future land use, mobility, parks, recreational resources, and more.



Citywide strategies from Comprehensive Plan 2000, the 2002 Blueprint Denver land use and transportation plan and the 2003 Game Plan for parks and recreation have served Denver well for the last decade and a half. They have guided our transportation choices; promoted new mixed-use development; created and enhanced parks, trails and recreation centers; and catalyzed areas of change while preserving the character of stable neighborhoods.

But a lot has changed since those plans were adopted.

RTD's FasTracks system has added significant new transit options to the region. Our population has experienced rapid growth. We've learned smarter and more modern ways to plan for the future of our city with inclusivity and climate change in mind.

Denveright represents an unprecedented opportunity to align citywide plans to guide future investments so that the whole is greater than the sum of its parts. Denveright strategies come straight from the community, and are designed to help the city prepare for and deliver a future that is responsive to their goals, visions and priorities.

## Your Vision for Denver

You helped planners create six “vision elements” that serve as the foundation for each plan and drive each plan’s goals.

Equitable,  
Affordable and  
Inclusive



Economically  
Diverse and  
Vibrant



Environmentally  
Resilient



Well Connected,  
Safe and  
Accessible Places



Healthy and  
Active



Strong and  
Authentic  
Neighborhoods



## Your Voice

Thousands of Denverites shared their unique perspectives on what makes Denver great and how it can evolve to be even better. You shared your voice in many ways – by attending meetings and workshops; taking online map-based surveys; talking with the Denveright street team at festivals, community events and transit stations; joining a Community Think Tank; and more. Through coordinated Denveright outreach and the individual plans’ efforts, there were limitless opportunities to help shape our city’s future.



# Denveright.

Your Voice. Our Future.

## Comprehensive Plan

The comprehensive plan — an update of the city's guiding vision from 2000 — reflects the voice of Denver today on issues spanning land use, mobility, parks, neighborhood authenticity, equity, economic growth, arts, culture and sustainability. This modern comprehensive plan will chart the course of the Mile High City for 20 years.

## Blueprint Denver

Civic leaders who had a vision for Denver in 2002 created Blueprint Denver, a citywide plan to link land use and transportation. Innovative for its time, the plan served us well — promoting a walk- and bike-friendly city, increasing transit service on major corridors, more housing in mixed-use areas, and directing new development to areas where growth is most appropriate. Based on community input, the Blueprint Denver 2018 update focuses on creating a blueprint for an inclusive city made up of “complete” neighborhoods with infrastructure and amenities, diversity of housing choices, further attention to urban design, and more.

## Parks & Recreation Game Plan

In a city as active and outdoor-oriented as Denver, a great parks system is essential to our quality of life. In 2003, a community-based process created the first Game Plan, which emphasized the vision of “a city in a park” and set priorities on the environment, engagement, equity and sound economics. With the updated Game Plan for a Healthy City, we're responding to climate change, growth, increased use and a lack of funding by prioritizing new parks, recreation and community programming, drought resiliency and upgrading existing facilities.

## Denver Moves: Transit

As our population grows, Denver needs more transportation choices to move more people efficiently and safely on our existing street network. For the first time, and with input from the community, Denver is creating a 20-year transit vision and implementation plan for Denver. The Denver Moves: Transit plan creates a local transit vision by convening community conversations to understand the existing transit system and how we can make it even better for all Denver residents, workers and visitors.

## Denver Moves: Pedestrians & Trails

The Denver Moves: Pedestrians & Trails plan will help make walking a viable and primary way for people to get around town and access recreational resources — comfortably and safely. With guidance from the community, the plan identifies citywide needs and defines priorities for improving and connecting Denver's pedestrian and off-street trail network; it also examines costs, funding options and policies to achieve the community's vision.

PREPARED BY:

**FEHR & PEERS**

WITH SUBCONSULTANTS:

