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# TABLE OF CONTENTS

## 6 INTRODUCTION & OVERVIEW

7 Introduction  
8 Study Purpose  
9 Study Area  
11 Study Process

## 13 RIVER CORRIDOR BACKGROUND

14 History of the South Platte River  
18 Current River Corridor Conditions

## 20 GOALS, OBJECTIVES & ENGAGEMENT

21 Existing City and County of Denver Goals  
22 Community Input on Draft Goals and Objectives  
23 HRCS Goals and Objectives

## 27 ACHIEVING A HEALTHY RIVER CORRIDOR

28 Understanding the Space  
30 Case Studies from Peer Cities  
31 The South Platte River as a Healthy River Corridor  
32 The Influence Zone

## 34 INFLUENCE ZONE OPPORTUNITIES

36 FEMA Floodplain  
39 Riparian Quality  
43 Access, Mobility & Recreation  
48 Land Use  
52 Urban Heat Island

## 56 ECONOMIC BENEFITS OF A HEALTHY RIVER CORRIDOR

57 Methodology  
54 Modeshift, Health & Tree Benefits

## 60 IMPLEMENTATION

61 Next Steps & Supporting Strategies

## 65 APPENDICES

66 A. River Protection Zone Precedents  
75 B. Habitat Quality Methodology  
77 C. Economic Benefits Technical Memo
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Map of the South Platte River Corridor</td>
</tr>
<tr>
<td>2</td>
<td>Map of the Corridor Character Areas</td>
</tr>
<tr>
<td>3</td>
<td>Study Process &amp; Engagement Timeline</td>
</tr>
<tr>
<td>4</td>
<td>Public Meeting Locations &amp; DOTI Equity Index</td>
</tr>
<tr>
<td>5</td>
<td>Topography of the South Platte River Basin</td>
</tr>
<tr>
<td>6</td>
<td>1930s Redlining Map overlaid with Railroads, Bridges &amp; Viaducts of the Era</td>
</tr>
<tr>
<td>7</td>
<td>Completed Plans along the South Platte River Corridor</td>
</tr>
<tr>
<td>8</td>
<td>South Platte River Needs Assessment - Health Needs Diagrams</td>
</tr>
<tr>
<td>9</td>
<td>Frequency of Goals Mentioned in Existing City Plans</td>
</tr>
<tr>
<td>10</td>
<td>Community Engagement Comments by Goal Category</td>
</tr>
<tr>
<td>11</td>
<td>Natural Waterway Zones</td>
</tr>
<tr>
<td>12</td>
<td>Aquatic Buffers Width Correlated to Ecological Functions</td>
</tr>
<tr>
<td>13</td>
<td>Acreage of Riparian Habitat along Denver's Tributaries</td>
</tr>
<tr>
<td>14</td>
<td>Map of Denver's Tributaries</td>
</tr>
<tr>
<td>15</td>
<td>Illustrative Diagram of Space in the Influence Zone</td>
</tr>
<tr>
<td>16</td>
<td>Corridor-Wide Floodplain Map</td>
</tr>
<tr>
<td>17</td>
<td>Acres of Floodplain in the Influence Zone</td>
</tr>
<tr>
<td>18</td>
<td>Acres of 100-Year Floodplain by Character Area</td>
</tr>
<tr>
<td>19</td>
<td>North Character Area Floodplain Map</td>
</tr>
<tr>
<td>20</td>
<td>Downtown Character Area Floodplain Map</td>
</tr>
<tr>
<td>21</td>
<td>Mid-City Character Area Floodplain Map</td>
</tr>
<tr>
<td>22</td>
<td>South Character Area Floodplain Map</td>
</tr>
<tr>
<td>23</td>
<td>Corridor-Wide Riparian Habitat Map</td>
</tr>
<tr>
<td>24</td>
<td>Acres of Riparian Habitat by Character Area</td>
</tr>
<tr>
<td>25</td>
<td>North Character Area Riparian Map</td>
</tr>
<tr>
<td>26</td>
<td>Downtown Character Area Riparian Map</td>
</tr>
<tr>
<td>27</td>
<td>Mid-City Character Area Riparian Map</td>
</tr>
<tr>
<td>28</td>
<td>South Character Area Riparian Map</td>
</tr>
<tr>
<td>29</td>
<td>Corridor-Wide Access, Mobility &amp; Recreation Map</td>
</tr>
<tr>
<td>30</td>
<td>Miles of Transportation Facilities in the Influence Zone</td>
</tr>
<tr>
<td>31</td>
<td>Acres of Parks &amp; Open Space in the Influence Zone</td>
</tr>
<tr>
<td>32</td>
<td>North Character Area Mobility &amp; Recreation Map</td>
</tr>
<tr>
<td>33</td>
<td>Downtown Character Area Mobility &amp; Recreation Map</td>
</tr>
<tr>
<td>34</td>
<td>Mid-City Character Area Mobility &amp; Recreation Map</td>
</tr>
<tr>
<td>35</td>
<td>South Character Area Mobility &amp; Recreation Map</td>
</tr>
<tr>
<td>36</td>
<td>Corridor-Wide Land Use Map</td>
</tr>
<tr>
<td>37</td>
<td>Acres of Existing Land Use in the Influence Zone</td>
</tr>
<tr>
<td>38</td>
<td>Chart of Land Use by Ownership Type</td>
</tr>
<tr>
<td>39</td>
<td>North Character Area Land Use Map</td>
</tr>
<tr>
<td>40</td>
<td>Downtown Character Area Land Use Map</td>
</tr>
<tr>
<td>41</td>
<td>Mid-City Character Area Land Use Map</td>
</tr>
<tr>
<td>42</td>
<td>South Character Area Land Use Map</td>
</tr>
<tr>
<td>43</td>
<td>Corridor-Wide Urban Heat Island Map</td>
</tr>
<tr>
<td>44</td>
<td>Acres of Urban Heat Island in the Influence Zone</td>
</tr>
<tr>
<td>45</td>
<td>Acres of Urban Heat Island by Character Area</td>
</tr>
<tr>
<td>46</td>
<td>North Character Area Urban Heat Island Map</td>
</tr>
<tr>
<td>47</td>
<td>Downtown Character Area Urban Heat Island Map</td>
</tr>
<tr>
<td>48</td>
<td>Mid-City Character Area Urban Heat Island Map</td>
</tr>
<tr>
<td>49</td>
<td>South Character Area Urban Heat Island Map</td>
</tr>
</tbody>
</table>
INTRODUCTION & OVERVIEW
INTRODUCTION

The South Platte River extends 12.5 miles through the City and County of Denver from its border with Adams County on the north to Englewood on the south. Historically, the riverbed and surrounding low lying topography have been home to railroads, industry and infrastructure and subject to reoccurring flooding. After years of continued infrastructure decisions and channelization, the South Platte River is, in many locations through Denver, a “back door” rather than a visible, accessible community asset.

Over the past decade, Denver has experienced significant growth in population placing pressure on the city’s riverfront for increased redevelopment, mobility options and urban recreational opportunities, competing with what little remains of the river’s natural beneficial function. These urban pressures, coupled with changing climate concerns, force the City and County of Denver to examine the future of its urban waterways. Like many cities across the United States, Denver is reclaiming its river corridor through preservation, enhancement and recognition of these resources as resilient community assets and critical elements of the urban environment.

The City and County of Denver, along with partners such as Mile High Flood District, the Greenway Foundation and Urban Land Institute, recognize that the South Platte River corridor is more than the water that flows through its channel. The South Platte River is part of a larger 87-mile network of watersheds, interconnected streams, floodplains, and ground water. It is a living system in the urban environment that shapes, and is shaped, by the landforms and vegetation around it. Its natural ecosystem provides numerous benefits such as habitat for plants and animals, water filtration, flood risk reduction, spaces for outdoor life and community activity. Despite recent years of investment in the river, improvement is still needed for these systems to function successfully.
**Water Policy in Denver**

Policy direction supporting the future health of the South Platte River and supporting tributaries is established through the Denver One Water Plan, Comprehensive Plan 2040, Blueprint Denver and Game Plan. Policies within these plans provide the framework for exploring room along our waterways, enabling an improved ecological condition and supporting the river as an integrated community asset.

In 2021 the City and County of Denver completed the [Denver One Water Plan](#) which determined policy and proposed action items for implementation going forward. The Plan called for the City to:

- **Goal 5.1** - Integrate water aspects of the City and County of Denver’s Green Infrastructure Implementation Strategy, Denver Living Streets, Water Quality Management Plan, and Storm Drainage Master Plan
- **Goal 5.2** - Integrate stormwater into the built environment in a socially, economically, and environmentally beneficial way by using low impact development/green infrastructure to improve water quality, reduce runoff, and mitigate the risk of urban regional flooding
- **Goal 5.3** - Preserve, restore, and maintain functional ecosystems emphasizing healthy waterways stream networks and lakes

**STUDY PURPOSE**

Through the Healthy River Corridor Study (HRCS), the City and County of Denver’s Department of Transportation and Infrastructure (DOTI), Denver Parks and Recreation (DPR), Community Planning & Development (CPD) and the Mile High Flood District, examined the vision for a healthy urban river corridor that restores and enhances the natural beneficial function of Denver’s waterways, improves the user experience, and builds community and economic vitality along the banks of the South Platte River.

The HRCS builds upon the existing conditions identified along the river corridor in the South Platte River Corridor Needs Assessment conducted by Mile High Flood District and the City and County of Denver in 2022. The HRCS sets forth a cohesive sense of direction for the future of the South Platte River corridor. Through this study, the City and County of Denver establishes the HCRS Goals and Objectives and defines the space needed along the corridor to address the health and future character of the river. The HRCS includes the following components:

- **The history of the river and its effects on today's conditions**;
- **The Goals and Objectives for a future healthy river corridor**;
- **A collaborative engagement process including the City, stakeholders and community**;
- **Opportunities and benefits associated with space along the river corridor**;
- **Implementation strategies for a healthy river corridor**.
THE STUDY AREA

The HRCS recognizes the South Platte River as part of a network of 14 tributaries in Denver but specifically addresses needs and recommendations for the South Platte River corridor, extending 12.5 miles through the City from Adams County to Englewood.

12.5 MILES OF RIVER

22.9 MILES OF TRAILS

55 PARKS

39 ACRES OF RIPARIAN HABITAT

356 ACRES OF FLOODPLAIN

72 ACRES OF URBAN HEAT ISLAND
CORRIDOR CHARACTER AREAS

The HRCS utilizes the four Character Areas identified in the South Platte River Corridor Needs Assessment (2022) to provide a contextually sensitive approach to assessing space along the river. Each Character Area has its own unique relationship with the river corridor based on years of industrial or commercial use, transportation infrastructure, flood management measures, redlining practices and equity concerns.

City North

The City North Character Area spans from the northern limits of the City and County of Denver at 52nd Avenue to Park Avenue West bridge. This area includes a mix of multi-unit residential, mixed-use industrial and event venues adjacent to the river, as well as the historic neighborhoods of Globeville, Elyria-Swansea and Five Points.

Downtown

The Downtown Character Area spans from the Park Avenue West bridge to Colfax Avenue and features a mix of office, entertainment, recreational and residential uses. This stretch of the river accommodates both residents and visitors and includes the adjacent neighborhoods including Sunnyside, Highland, Jefferson Park, Auraria and all of Downtown.

Mid-City

The Mid-City Character Area spans from Colfax Avenue to W. Louisiana Avenue. The area is highly industrial along the western edge of the river with I-25 occupying the eastern side of the river. Neighborhoods include Sun Valley, Valverde, Athmar Park, Lincoln Park and Baker.

City South

The City South Character Area spans from W. Louisiana Avenue to the southern limits of the City and County of Denver at Dartmouth Street and is home to a mix of single family residential use and mixed-use industrial along the river’s edge. Neighborhoods within this Character Area include Ruby Hill, Platt Park, College View and Overland.
STUDY PROCESS & ENGAGEMENT

The HRCS followed a 10-month process to review the conditions and constraints along the river and its tributaries, identify Goals for the future of Denver’s waterways and evaluate the space needed for the long-term health and character of the river corridor. Throughout the process several key groups participated in the study, reviewed the findings and informed the direction and key recommendations of the study.

Figure 3 illustrates the integrated study and engagement process for the HRCS:

---

**Project Management Team (PMT)**

The PMT was an interdepartmental group that met monthly throughout the study process to foster department participation, coordinate communication across departments and ensure technical support of the evaluation process and development of recommendations. The PMT included staff from Mile High Flood District, as well as the City and County of Denver Department of Transportation and Infrastructure, Community Planning & Development, Parks and Recreation, Public Health & Environment, Finance and the City Attorney’s office. The PMT was instrumental in determining the final recommendations and implementation strategy for the study.

---

**Stakeholder Committee**

The Stakeholder Committee was assembled as a diverse and collaborative committee to inform the study team of a broad range of needs and issues concerning the river corridor and tributaries. Representatives included the Greenway Foundation and other natural resource agencies, open space and conservation groups, private developers specifically working along the river corridor such as River Mile, educational organizations such Urban Land Institute and the University of Colorado and other economic and planning groups impacted by river corridor decisions. The Stakeholder Committee convened four times during the course of the study and played a key role in reviewing progress and sharing ideas for the future river corridor.
Community

In addition to the Stakeholder Committee, the team organized an educational program for the public to increase awareness around the South Platte River corridor, its tributaries and to create specific opportunities to share information and gather feedback on community needs and interests.

The project team organized a series of six in-person community meetings along the South Platte River corridor, many of which were held in historically underserved neighborhoods. The team shared materials on the river’s history, river ecology, existing conditions and draft goals and objectives for the future of the river and its tributaries. Community members shared their own thoughts, values and experiences of the river corridor, weighed in on the use of space along the corridor and provided distinct feedback on the goals and objectives. The community meeting series brought invaluable insight into the public’s experience of the river. Through conversation and notes, attendees provided feedback that informed the study outcomes and final goals and objectives and commended the efforts underway to reimagine the river corridor.

The South Platte River: Healthy River Corridor Study Website was created to share and gather information on this study and supporting efforts such as the The Waterways Resiliency Program and the South Platte River Corridor Needs Assessment (2022).
HISTORY OF THE SOUTH PLATTE RIVER

Our historic practices along the river have reshaped the fluvial geomorphology of the river; straightening, channelizing and eliminating its meandering riverbed characteristics and greatly reducing its functionality as a healthy river. Understanding these historic practices is an important part of planning for tomorrow’s solutions and the future of the South Platte River and its tributaries.

A Natural River - Pre 1800s

Over 600 years ago, the Ute, Cheyenne, and Arapaho tribes lived near the confluence of the South Platte River and Cherry Creek waterways, trading and hunting along their banks. These tribes understood the characteristics of the wide, sandy-bottomed South Platte River and warned early settlers about the flood risk dangers of building near its banks, and the banks of the nearby Cherry Creek. Early settlers contended with a waterway that carved a path across a 1-mile-wide riverbed that frequently flooded early development, especially at its confluence with the Cherry Creek. Figure 5 illustrates the topography and breadth of the early South Platte River.

Denver’s Early Days: Early 1800s

Early Denver was noted to have ideal topography and drainage conditions for development. A gentler slope to the east of the South Platte River allowed for easy settlement, while the western bank rose more sharply in elevation from the river and remained primarily
agricultural into the early 1900s. With the discovery of gold in 1858, miners and additional white settlers arrived at the confluence of the South Platte River and Cherry Creek, imposing upon the homeland of the Cheyenne, Ute, and Arapaho tribes and bringing growth in population.

Some of the early farmers along the South Platte River became quite successful and provided food to the growing mining population of the 1880s. Major flooding of the South Platte River and Cherry Creek through Denver wiped out many farms and structures along the banks and made clear the challenges of building near the waterways. Early flood control attempts of the Cherry Creek included the construction of Castlewood Dam in 1890 which held back nearly 1 billion gallons of water but was located too far south along the Cherry Creek to effectively mitigate flooding in the Denver area.

Industry Along The River: Late 1800s – 1930s

One of the biggest historical impacts on the South Platte River through Denver was the arrival of the railroads in the 1870’s and the subsequent industrialization of the river area. Rail lines occupied the majority of the low-lying land east of the South Platte River where topography was conducive to rail operations and commercial development. By the early 1900s, downtown Denver, situated east of the river and along the Cherry Creek, was bustling with activity and Union Station was the hub of passenger activity.

Into the 1920’s the river area grew in industry and commerce and flooding continued. The Flood Commission published findings in a 1923 issue of the Denver Municipal Facts suggesting a thorough study of the South Platte River should be completed. Within years, flood prevention work was underway to manage the river and protect growing development. Some of the earliest work took place in the Globeville area, where the smelting and meat packing industry thrived.
Demand for travel across the industrialized “river corridor” continued to grow and by 1933, ten bridges and six viaducts spanned the river, as illustrated in Figure 6. Bridges, industrial uses, railroad operations, and flood concerns were prevalent along the river. River-adjacent neighborhoods were home to many people of color, as well as immigrants to the city. By the 1930’s, these neighborhoods were subject to redlining, the practice of discrimination in home loans to residents. Home Owner Loan maps drawn by lending institutions racially targeted people of color and impacted the livelihood of residents of certain neighborhoods, including those along the river corridor. Sun Valley, Villa Park, Barnum, Valverde, Lincoln Park and Globeville/Elyria Swansea were identified as “Hazardous” or “Definitely Declining” and became the target of disinvestment, the effects of which are still felt within these communities today.

Figure 6: 1930s Redlining Map Overlaid with Railroads, Bridges & Viaducts of the Era
Floods and Dams: Mid to Late 1900s

In 1933, after an unusually wet spring and a very large thunderstorm, the Castlewood Dam collapsed, sending approximately 1.5 billion gallons of water down the Cherry Creek hurtling towards Denver. This devastating flood washed-out bridges, carried away houses, downed power and phone lines, and brought approximately 20,000 tons of silt to the Denver area which took a crew of 2,500 men to clean up. The Kenwood Dam was completed just two years after the 1933 collapse of Castlewood Dam. It was replaced by the United States Army Corps of Engineers in 1950 with the Cherry Creek Dam and Reservoir.

The construction of the Valley Highway in 1958 required the straightening, channeling and relocation of the South Platte River through the Valverde neighborhood in proximity of Alameda Ave. These actions not only magnified the barriers between the neighborhoods of Valverde and Lincoln Park, but they minimized the available riverbed, changed the ecological environment of the river and increased the speed and flow of water through this section of the river.

In 1965, heavy rains in the Castle Rock area and flows from the Plum Creek to the South Platte River flooded communities downstream including Denver. The 1965 flood impacted the I-25 corridor, Downtown, Valverde and Globeville significantly causing damages exceeding $4 billion in today’s dollars. To control flooding and protect Denver, Urban Drainage and Flood Control District was founded in 1969. Subsequently, two dams were built to manage water levels in the South Platte River: the Chatfield Dam in 1975 and Bear Creek Dam in 1982. Today, these two dams, along with Cherry Creek Reservoir, are fundamental to managing water levels in the South Platte River and Cherry Creek to mitigate flooding in the Denver area. Additional flood control projects for the South Platte River like the 2008 construction of the levee project through Globeville and today’s Globeville levee improvements continue to address flood concerns along the river.

River Improvements:
Late 1900s – Early 2000s

The Platte River Development Council was founded in 1974 by Mayor Bill McNichols and Senator Joe Shoemaker with the goals of reclaiming the South Platte River, creating open space and natural areas, creating a bike and pedestrian trail along the river, connecting improvements to existing amenities, and ensuring flood carrying capacity of the river. Riparian improvements were also constructed along the South Platte River, enhancing the corridor for wildlife habitat.

Despite the efforts of the 1970’s, the South Platte River remains channelized and constricted, edged out by I-25, rail yards and industrial use through much of the city. In many segments it is all but invisible to adjacent communities. An emerging trend to re-embrace the river, orient development to the river, and capture a sense of place inclusive of the river is underway today. Improvements to the Confluence of the Cherry Creek and South Platte River, ongoing efforts of the Greenway Foundation, and development plans for River Mile are examples of today’s efforts to rethink the City’s use of the river and its adjacent land.
CURRENT RIVER CORRIDOR CONDITIONS

Completed Plans

There are a handful of plans or studies that today guide the treatment of the South Platte River corridor. These plans pertain to portions of the river through Denver but do not cohesively address the length of the river or the direction for the river corridor as a distinct community asset. Figure 7 shows where completed plans have addressed conditions along the South Platte River Corridor.

The South Platte River Long Range Management Framework is the only plan to address the entire length of the corridor, and while comprehensive, it is now over twenty years old.

The Urban Waterways South Platte River Feasibility Report and Environmental Impact Statement identified riparian restoration as a priority for the South Platte River from the northern boundary with Adams County to just south of 6th Avenue. This effort led to today’s Waterway Resiliency Program which is funded by the Army Corps of Engineers and will begin in 2023 with the goal of ecosystem restoration.

SPR Section 1135 Ecosystem Restoration Study examined the river and floodplain within 200’ of either bank along a 2.4 mile section of the South Platte River. The environment was degraded by the construction of two existing Corps multi-purpose flood control dams and reservoirs (Chatfield and Bear Creek) approximately 11 miles upstream of the project area.

The River North Greenway Master Plan and subsequent The River South Greenway Master Plan were conducted to initiate a collaborative effort between citizens, property owners, and numerous public and private organizations along the corridor. The following goals resulted from these planning efforts:

- Create a healthy, habitable, and connected river-focused urban environment,
- Enhance the safety of the river corridor and the surrounding area
- Build on the current success and activity along the central South Platte River Valley
- Create a parks and open space model for urban living that reflects the history of Denver
- Utilize existing and proposed parks to create a sense of place and community focal points
- Connect neighborhoods and create links to adjacent communities and regional trail corridors

Figure 7. Completed Plans along the South Platte River Corridor
The South Platte River Needs Assessment (2022)

The South Platte River Corridor Needs Assessment was conducted in 2022 by the City and County of Denver and Mile High Flood District. The study identified a comprehensive range of needs along the 12.5-mile length of the river within the Denver municipal boundary from Dartmouth Avenue in the City of Englewood to 52nd Avenue in Adams County. The study included critical considerations such as the South Platte River basin geomorphology and sediment transport, regional hydrology and hydraulics, prioritization of natural systems, equitable high-quality human experiences, mobility and connectivity, and access to nature and recreation. The assessment focused on the evaluation and mapping of three key objectives: River Health, Human Experiences, and Connected Mobility. The multi-layered evaluation of these issues presents a comprehensive assessment of the river corridor needs. [South Platte River Corridor Needs Assessment ArcGIS Story Map](#)

The Needs Assessment included the organization of the river into fourteen (14) reaches and four primary character zones; City North, Downtown, Mid-City and City South. The detailed examination and mapping of conditions within each reach were documented and illustrated in the diagrammatic mapping of Figure 8 below. River Health needs are consistently high the length of the corridor while Connected Mobility needs are highest throughout the Mid-City and City South zones which are significantly impacted by the barriers of I-25, 6th Avenue interchange, Santa Fe Drive and the rail lines. Human experience needs are also highest throughout the Mid-City and City South zones with many recreational facilities separated from the river by infrastructure and industrial use. The information and mapping contained within the Needs Assessment serves as the framework for understanding the conditions along the river and supporting the direction of Healthy River Corridor Study.

The Needs Assessment utilizes a “river-centric” lens to identify gaps between existing and desired conditions of the South Platte River corridor with the intention of aiding the prioritization of future investment and holistic project planning for the City of Denver, the Mile High Flood District, and the complementary private ventures.

![Figure 8. South Platte River Needs Assessment - Health Needs Diagrams](#)
GOALS, OBJECTIVES & ENGAGEMENT
EXISTING GOALS

Over 140 existing goals and strategies relating to water, ecology, mobility and recreation, and land use have been identified in the six plans below. The HRCS efforts build upon these goals as a foundation for setting the direction for the South Platte River corridor. Through the study and engagement process, the HRCS Goals and Objectives were developed to establish a singular & cohesive direction for the South Platte River corridor.

Denver’s Existing Plans

Research from existing City and County of Denver plans identifies over 140 relevant goals related to water quality and flooding, climate and resiliency, the ecology of habitats, vegetation, and wildlife, access, mobility, recreation, and land use. The range of existing goals were organized in Figure 9 below for reporting purposes and used to inform and draft initial HRCS Goals and Objectives. This research, along with input from the Stakeholder Group, city departments and the community informed the development of the HRCS Goals and Objectives. Draft goals and objectives became a key component of the education and engagement process.

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<th>Frequency of Goals Mentioned in Existing City Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access &amp; Mobility</td>
</tr>
<tr>
<td>Water (Quality, Flooding, Waterways)</td>
</tr>
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<td>Climate &amp; Resiliency</td>
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<td>Health &amp; Recreation</td>
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<td>Land Use Character &amp; Design</td>
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<td>Ecology (Habitats, Vegetation, Wildlife)</td>
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<td>40 34 21 19 15 13 4</td>
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Figure 9.
COMMUNITY INPUT ON DRAFT GOALS AND OBJECTIVES

Community members expressed positive agreement with the overall direction of the study, and provided comment on the wording of the draft HRCS Goals and Objectives and overall South Platte River corridor needs:

**Water & Ecology**

Fewer comments were given about Water & Ecology. There was general curiosity about how human action and dogs swimming in the river impact water quality. Community members also expressed interest in how urban rivers could mimic natural watershed features, highlighting an interest in public education that could include educational signage along the river. Community members also expressed joy in having healthier fish populations and a desire to see more wildlife along the corridor.

**Mobility & Recreation**

Mobility and Recreation accounted for almost one-third of the comments. Many community members expressed wanting more river access from adjacent neighborhoods and developments and continuity and wayfinding for bike routes. There was also significant interest in how new light rail stations could connect to river pedestrian and bike networks. In addition, people wanted a greater "nature experience" and more recreational opportunities, especially in historically divested neighborhoods.

**Land Use & Development**

About a quarter of the comments related to Land Use and Development. There were concerns about socioeconomic and environmental equity in new development projects, desires to create and preserve spaces for small, local businesses, and a need for social gathering spaces. There was specific interest in reducing the area used for parking and pavement along the river’s edge. Strategies suggested by the community included “green” design guidelines and sustainable development incentives.
The study’s process of existing plan review and community engagement efforts revealed four distinct Goals: Water, Ecology, Mobility & Recreation, and Land Use & Development. Within these goals, the study team identified 30 unique Objectives that address both existing city-wide plan objectives and community priorities. These HRCS Goals and Objectives provide a balanced focus for transforming the South Platte River into a healthy urban corridor for the future.

**WATER**

**Goal #1**

*Protect Denver’s waterways from the encroachment of urbanization and recognize the waterway corridors as critical assets that safely convey water and sediment.*

**Objectives:**

1.1 Improve water quality
1.2 Preserve the floodplain
1.3 Reduce impervious surfaces
1.4 Strengthen urban flood resilience
1.5 Incentivize water management best practices
1.6 Improve sediment flow
1.7 Recharge groundwater in upland buffer zones
1.8 Reduce risk in vulnerable communities
Goal #2

Preserve, protect, and enhance the diversity of wildlife and ecological health along Denver’s waterways.

Objectives:

2.1 Improve riparian vegetation quality
2.2 Protect and enhance wildlife habitats
2.3 Increase wildlife corridor connectivity
2.4 Reintroduce native vegetation
2.5 Incentivize climate-resilient landscaping
2.6 Reconnect the floodplain
2.7 Enhance aquatic habitat with instream restoration
2.8 Incorporate educational opportunities
MOBILITY & RECREATION

Goal #3
Provide equitable access and space for active and passive recreation, parks and open space, and mobility options.

Objectives:

3.1 Increase public access to waterways
3.2 Connect neighborhoods to their local waterways
3.3 Prioritize safety
3.4 Promote active transportation
3.5 Provide mobility options for all ages and abilities, and space for related facilities
3.6 Increase recreational opportunities
3.7 Enhance wayfinding along the river
Goal #4
Enhance Denver’s waterways in an equitable and sensitive manner by integrating the built environment and future land use.

Objectives:

4.1 Promote land uses that complement corridor goals
4.2 Integrate future development to support corridor goals
4.3 Mitigate flood impacts on urban assets
4.4 Reflect the culture and identity of neighborhoods along the waterways
4.5 Reduce urban heat island effects
4.6 Create opportunities for water-focused businesses
4.7 Enhance the experience along waterways
ACHIEVING A HEALTHY RIVER CORRIDOR
Understanding the Space for a Healthy River Corridor

Over the last twenty years or more, cities across the United States have been taking steps to ensure there is adequate space along their waterways to effectively support hydrologic and ecologic functions of the river, the riparian and wildlife health of the corridor, and the community’s interface with the waterway. Understanding the space needed to achieve a Healthy River Corridor is key to assessing today’s South Platte River conditions and identifying the opportunities to achieve the HRCS Goals and Objectives.

Waterways need room to function and space to protect not only the water but the health of the ecology along the water’s edge. The different zones along a waterway provide beneficial ecosystem services and wildlife habitats that are essential to the function of the waterway, especially in a constrained urban environment. As illustrated in the graphic, space along a healthy waterway includes the active waterway channel, the floodplain, and the upland zone, and the environment for wildlife.

The Active Channel

The active channel supports a complex web of aquatic life, moves sediments, and provides aesthetic and recreational opportunity. Engineered solutions are frequently used in urban areas to maintain channel stability, but vegetated banks also help to protect infrastructure, improve safety, and reduce excessive erosion. Plant roots protect soil in stream banks reducing the amount of streambank erosion. Water temperatures are usually elevated in urban areas which often exceed the tolerances of aquatic lifeforms and can result in a degraded food web. However, trees and vegetation can serve to shade the water, and reduce temperatures.

In Denver, the active channel, varies between about 50’–150’ depending on location along the waterway and seasonal water levels. The active channel is part of the Official Channel of the South Platte River which spans a width of 150’–200’ along the corridor, as identified on quarter section maps on file in the office of the City Engineer within the Department of Transportation and Infrastructure.

The Floodplain

The frequently inundated terraces along the edge of the active channel are critical for flood resilience, groundwater recharge, and water storage. If high water flows cannot escape the active channel to inundate the floodplain where it can slow down and recharge groundwater, downstream flooding is often worse. The width of these zones varies with the river flows, and historically their extent and configuration would shift along with the active channel in a naturally migrating waterway. These terraces also provide critical habitats for fish, frogs and salamanders.
**The Upland Zone**

In the wider envelope surrounding a river, the upland zone provides some of the most important ecosystem services and benefits. The longer that water can stay in contact with soil and roots, the more opportunity it has to reduce pollutants picked up while draining towards the river. This area also presents management opportunities for water storage, where landscapes and structures can be designed to accept and even hold water during flood events. Improvements to water quality are directly correlated with the width of this zone alongside the channel. Wider corridors also provide better and more continuous habitats for a broad range of birds, small mammals, reptiles, insects, and amphibians.

**Wildlife Habitat**

Denver’s interconnected waterways offer a haven for a wide array of animal species. Birds, small mammals, reptiles, and amphibians can all be found in urban waterways depending on the amount of space and health of the environment. Beavers, traditionally associated with wild spaces, can be found along Denver’s urban waterways. Although urban habitats may differ significantly from their wildland counterparts, they are still able to support healthy beaver populations that fill similar ecological roles that they would elsewhere. Their dams can create meandering features as well as longer residence times leading to cleaner water and more riparian habitat. Beavers are also known to remove vegetation which can be advantageous for maintaining a heterogeneous landscape. Urban beavers primarily stick to waterways that have interconnected natural floodplain corridors and low human traffic.

Amphibians can also be found in Denver’s urban waterways, offering a range of benefits. For example, salamanders have breathable and permeable skin that absorbs contaminants faster. Because of that, their presence can be health indicators of the environment.

Scientific literature suggests the effectiveness of ecological functions of waterways increases in relation to the width of aquatic buffers. A minimum of 25’–50’ is necessary to protect bank stabilization and provide stream shading for rivers and waterways. Wider buffers ranging from 100’–300’ achieve additional benefits including improvements to water quality protection, flood water storage and healthier wildlife habitats. Figure 12 illustrates the correlation between the width of an aquatic buffer and the ecological benefit along a waterway.

---

**Aquatic Buffer Width Correlated to Ecological Functions**

- **Bank Stabilization**
- **Stream Shading**
- **Water Quality Protection**
- **Flood Water Storage**
- **Wildlife Habitat**

**Figure 12.** Adapted from USDA Natural Resources Conservation Service. Where the Land and Water Meet: A Guide for Protection and Restoration of Riparian Areas First Edition. USDA NRCS, September 2003.
Many cities have taken steps to identify the needed space along their critical waterways and address a range of goals and functions relevant to their urban context. Peer cities and best practices help define the concept of creating “room for the river” and defining space ranging from 20’-300’ to provide the capacity to address everything from ecological restoration and wildlife habitat to recreation, mobility and supporting land uses. The peer cities below and others across the nation have set the standard for healthy rivers and river edges. Additional peer city approaches can be found in Appendix A.

**CITY SPOTLIGHT:**

**Buffer Zones in Colorado Springs**

The Colorado Springs Streamside Overlay (SS) zone utilizes two buffers that work together; an inner and outer buffer zone. The inner buffer zone is measured from the toe of the channel bank, and extends 20’-40’ depending on the size of the stream. The outer buffer zone extends an additional 50’-80’ beyond the inner zone. These two zones work together to create a total buffer width as small as 70’ for smaller waterways (<25’ channel), and 120’ buffer for larger waterways (>75’ channel).

[Click to Visit: Colorado Springs Streamside Overlay Webpage](#)

**CITY SPOTLIGHT:**

**Setbacks in Boise, Idaho**

Boise crafted its river-oriented regulations to protect its river, greenbelt, and bird habitats. The Boise River System Ordinance (1997) established a River System Management District and Overlay District to implement setbacks that vary according to different wildlife habitats. A 70’ setback from the river flow line is required for all buildings within the designated greenbelt, but a 200’ setback is required around Bald Eagle habitats and 300’ for Great Blue Heron habitats.

[Click to Visit: Boise’s Interactive Setback Map](#)

**CITY SPOTLIGHT:**

**Water Quality–Based Buffers in Austin, Texas**

Austin, Texas uses Critical Water Quality Zones (CWQZ) to set widths for waterway buffers. CWQZ’s align with the 100-year floodplain and increase in width if additional environmental concerns are present, or for unique waterway assets such as the popular Barton Creek area. Buffer widths also vary according to the size of the waterway. 100’ buffers are used for minor waterways (drainage area of at least 64 acres), 200’ for intermediate waterways (drainage area >320 acres), and 300’ for major waterways (drainage area >640 acres).

[Click to Visit: Austin’s Watershed Protection Ordinance Webpage](#)
The South Platte River as a Healthy River Corridor

The South Platte River is part of a larger 87-mile network of watersheds and interconnected streams, floodplains, and groundwater that work together to support the health of Denver’s water resources. Denver’s 14 main tributaries feed the South Platte River and support the health and ecology of the river itself. These tributaries, listed in Figure 13, provide roughly 320 acres of riparian habitat along their waterways. However, half of that acreage occurs along First, Second, and Third Creeks in the northeast corner of the City and County of Denver as illustrated in Figure 14, while the gulches and creeks through the core of the City have the lowest acreage of all tributaries, at 1% or less.

These tributary conditions, the channelized and constrained state of the South Platte River today, and increasing development and recreational pressure along the waterway result in the need to establish room for a healthier functioning river and room to address the Goals and Objectives of the HRCS.

<table>
<thead>
<tr>
<th>Tributaries</th>
<th>Riparian Habitat within 50’ (Acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Creek</td>
<td>61.92</td>
</tr>
<tr>
<td>Second Creek</td>
<td>56.11</td>
</tr>
<tr>
<td>First Creek</td>
<td>51.05</td>
</tr>
<tr>
<td>Cherry Creek</td>
<td>40.81</td>
</tr>
<tr>
<td>Westerly Creek</td>
<td>24.60</td>
</tr>
<tr>
<td>Bear Creek</td>
<td>19.46</td>
</tr>
<tr>
<td>Sand Creek</td>
<td>19.19</td>
</tr>
<tr>
<td>Box Elder Creek</td>
<td>13.25</td>
</tr>
<tr>
<td>Harvard Gulch</td>
<td>3.47</td>
</tr>
<tr>
<td>Lakewood Gulch</td>
<td>2.33</td>
</tr>
<tr>
<td>Dry Gulch</td>
<td>2.04</td>
</tr>
<tr>
<td>Weir Gulch</td>
<td>1.07</td>
</tr>
<tr>
<td>Sanderson Gulch</td>
<td>0.24</td>
</tr>
<tr>
<td>West Harvard Gulch</td>
<td>0.15</td>
</tr>
<tr>
<td><strong>Total Riparian Habitat</strong></td>
<td><strong>318.4 Acres</strong></td>
</tr>
</tbody>
</table>

*Figure 13. Acreage of Riparian Habitat along Denver's Tributaries*

*Figure 14. Map of Denver’s Tributaries*
For the South Platte River to act as a Healthy River Corridor, the constrained and impactful edge conditions today must be recognized. Space along the South Platte River needs to allow room for an effective floodplain and upland zone, as well as room for riparian habitat, recreational use, mobility options, and supporting land use, as called for in the HRCS Goals. The existing conditions identified through the South Platte River Needs Assessment, as well as the Peer City examples and research, provided a base for the consideration of a range of 20’–300’ of space along the river to positively influence future conditions in line with the HRCS Goals. The potential to influence a future river edge and environment was most impactful from 50’ to roughly 200’, where riparian habitat, parks, trails, roadways, utilities and some land uses were prevalent. Beyond 200’, natural conditions were replaced by denser existing land use patterns. Based on the review and evaluation, it was determined in coordination with City departments and stakeholders, that a width of 200’ from the edge of the Official Channel of the South Platte River was a reasonable distance to prioritize river health, shade, improved water quality, flood control and future mobility and recreational enhancements.

The 200’ space on either side of the South Platte River and measured from the edge of the Official Channel of the South Platte River was termed the Influence Zone and was determined to consist of two areas:

**The Riparian Priority Area** – The initial 50’ from the edge of channel will be prioritized for the reestablishment of water quality and riparian function, generally free of new structures or additional infrastructure. Because of its critical role in defining riparian space, this 50’ Riparian Priority Area will apply to the South Platte River and all contributing waterways within the City and County of Denver.

**The Health and Access Area** – The next 150’ beyond the Riparian Priority Area will support the long-term prioritization of the HRCS Goals and Objectives by defining the space for future connectivity, recreational or natural space enhancements and the supporting interface with adjacent land use. The 150’ Health and Access Area will apply only to the South Platte River and will be studied in the future for contributing waterways.

The application of the 200’ Influence Zone, consisting of both the 50’ Riparian Priority Area and the 150’ Health and Access Area, includes the prioritization of future improvements, programs, or actions that support the HRCS Goals and Objectives. The application of the 200’ Influence Zone does not require the discontinuation of existing uses within the 200’ today, nor does it require the acquisition or condemnation of properties within the 200’ today. The HRCS Goals and Objectives and the identification of the 200’ Influence Zone establish a direction for future investment and future changing conditions.

On the following page, Figure 15 illustrates the concept of the South Platte River as a future Healthy River Corridor with space allocated to the channel and ecological function, the Riparian Priority Area and the Health and Access Area.
In addition to the active channel, ecological function and riparian habitat of the South Platte River, the Influence Zone will address the HRCS Goals associated with the Health & Access Area.

Adjacent land use mix and interface at the river corridor should complement water, ecology, mobility and recreation HRCS Goals to successfully create an active urban edge to the river corridor. Land use interface should address adjacent site design and orientation, ground floor design and activation, ensure public access to the waterway and reflect unique aspects of the Character Area in which it sits. New development or redevelopment at the water’s edge should enhance the sense of place and experience of the corridor for all users.

Room for recreation or natural space should be found within the zone adjacent to the ecological function and support both the river’s edge and land use interface. These improvements should intertwine with opportunities for increased public access and supporting trail networks that improve the experience of the river and connect our communities. Space for mobility improvements should be located between the natural or recreational uses and the land use interface and should be designed to accommodate a range of users, and support the South Platte River corridor as a mobility spine through Denver.
INFLUENCE ZONE
OPPORTUNITIES
IDENTIFYING OPPORTUNITIES

This chapter identifies the impacts and benefits of the 200’ Influence Zone along the South Platte River corridor. The evaluation measures the opportunity to positively influence conditions along the river and potentially transform the future of the corridor for a range of functions.

METRICS MEASURED FOR EACH GOAL

- FEMA Floodplain Presence
- Riparian Presence & Quality
- Frequency of Parks & Open Space & Pedestrian, Cyclist & Transit Facilities
- Land Use Composition & Urban Heat Island
The South Platte River’s floodplain is a critical part of the river and its riparian system, providing ecosystem benefits such as water storage and water quality improvement.

FEMA defines Special Flood Hazard Areas that will be inundated by the flood event having a 1% (~100 year) or 0.2% (~500 year) chance of occurring and being equaled or exceeded in any given year.

For each of the Character Areas, both the 100-year and 500-year FEMA floodplains were mapped within the 50' and 200' Influence Zone on each side of the South Platte River.

**FEMA 100-Year Floodplain** (2022)

**FEMA 500-Year Floodplain** (2022)
FEMA FLOODPLAIN BY CHARACTER AREA

The acreage of FEMA Floodplain within the Influence Zone varies by Character Area. The 100 year floodplain is mainly confined within the 50’ Riparian Priority Area in the North and Downtown Character Areas, while significantly more floodplain exists within the 150’ Health and Access Area within the Mid-City and South Character Areas.

The North

In the North Character Area, 24 acres of the 500-year floodplain is mostly confined to the channel itself, primarily contained by berms/levee and steep banks. 67 acres of 100-year floodplain are present, spilling outside the river channel in Elyria Swansea, near Five Points, and near the Park Avenue Bridge.

Downtown

The Downtown Character Area contains more acreage of floodplain than the north, with 47 acres of 500-year floodplain and 68 acres of 100-year floodplain. Outside the Influence Zone, significant portions of both the 100 and 500-year floodplains spill into the Auraria Neighborhood and near Colfax Ave.

Figure 18. Acres of 100-Year Floodplain by Character Area

<table>
<thead>
<tr>
<th>Character Area</th>
<th>50’ Riparian Priority Area</th>
<th>150’ Health &amp; Access Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downtown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid-City</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 19. North Character Area Floodplain Map

Figure 20. Downtown Character Area Floodplain Map
Mid-City
The Mid-City Character Area has the most acreage of 500 and 100-year floodplains, but also contains a longer stretch of the river than the other character areas. 92 acres of 500-year floodplain and 113 acres of 100-year floodplain exist in the Mid-City Character Area within the Influence Zone. Outside the Influence Zone, the floodplain occupies significant areas of Lincoln Park, Valverde, and Athmar Park, mostly to the west of the channel.

The South
The South Character Area has the second most acreage of floodplain, with 48 acres of 500-year floodplain and 107 acres of 100-year floodplain within the Influence Zone. On the east side of the river, significant areas of 500-year floodplain spill out into the Overland Golf Course and further, then further on into the neighborhood. On the west side of the river, both the 100 and 500-year floodplains occupy the College View Neighborhood.
High-resolution land cover data from the Denver Regional Council of Governments (DRCOG) from 2019 were analyzed to understand areas of existing natural vegetation and potential habitat values in Denver (excluding irrigated turf).

These data were used to characterize regional habitat quality within a seven-county metro area based on cover type, habitat patch characteristics, and known biodiversity. Because of the number of projects along the river, the assessment offers a snapshot of a moving target, which can nevertheless serve to inform future opportunities for improvement.

Habitat along most of the South Platte River is of moderate to low quality levels and acreages are low compared to Denver's other waterways. The city's highest quality riparian areas are found outside of the South Platte River corridor along First, Second, and Third Creeks. However, The Waterway Resiliency Program will improve the riparian quality of the South Platte River north of 6th Avenue.

Habitat quality levels were determined through the recently completed Regional Conservation Assessment for the Nature Conservancy (Biohabitats, 2022). Five indicators were used to evaluate regional habitat based on regional data coverage. Details of the methodology and scoring can be found in Appendix B.

**Riparian Quality Levels**

- **691 - 820** Highest Quality
- **611 - 690**
- **511 - 610**
- **411 - 510**
- **341 - 410**
- **281 - 340**
- **231 - 280**
- **120 - 230** Lowest Quality
RIPARIAN PRESENCE & QUALITY
BY CHARACTER AREA

The presence and amount of riparian vegetation in the Influence Zone varies throughout each character area. Increasing the amount and quality of vegetation across all character areas will benefit habitat connectivity, slow and store floodwater, improve water quality, reduce heat island impacts, and enhance aesthetics.

The North

The North Character Area has seven acres of riparian vegetation in the 50' Riparian Priority Area and two extra acres within the 150' Health & Access Area. Vegetation occurs in small patches, relatively evenly distributed between the river’s edge and adjacent upland areas. A band of higher quality riparian vegetation (shown in dark green) occurs north of I-70 on east side of the river, near the National Western Center, in an area slated for further improvements by the U.S. Army Corps of Engineers.

Downtown

The Downtown Character Area has a low amount of riparian vegetation; only two acres within the 50' Riparian Priority Area and four acres within the 150' Health & Access Area. The majority of the riparian vegetation exists in a larger, medium quality patch located between Auraria and Jefferson Park, near the Denver Aquarium and Children’s Museum. Very little riparian vegetation can be found along the river between Downtown, Highland and Sunnyside.
**RIPARIAN QUALITY BY CHARACTER AREA**

**Mid-City**
The Mid-City Character Area contains over twice the acreage of riparian vegetation in the Influence Zone compared to other character areas; eight acres in the 50' Riparian Priority Area and 9 acres within the 150' Health and Access Area. This is also the only character area with more riparian vegetation in the 150' Health & Access Area than the 50' Riparian Priority Area. Large, continuous bands of vegetation can be found on both sides of the river, although the quality of the vegetation is moderate to low quality.

**The South**
The South Character Area has five acres of riparian habitat within the 50' Riparian Priority Area and one additional acre within the 150' Health and Access Area, meaning almost all of the riparian vegetation is found near the river’s edge. A large band of healthy riparian vegetation can be seen in dark green near Grant Frontier Park, due in part to successful restoration efforts in recent years by the City and County of Denver.

![Figure 27. Mid-City Character Area Riparian Habitat Map](image1)

![Figure 28. South Character Area Riparian Habitat Map](image2)
## WATER & ECOLOGY | KEY TAKEAWAYS

<table>
<thead>
<tr>
<th>CONDITIONS EVALUATED</th>
<th>FINDINGS IN 200’ INFLUENCE ZONE</th>
<th>POTENTIAL OPPORTUNITIES OF A 200’ INFLUENCE ZONE</th>
</tr>
</thead>
</table>
| Riparian Quality & Habitat | 39 acres of riparian habitat (4% of 200’ Influence Zone) | Within the Riparian Priority Area (50’) increase future riparian habitat up to a possible 136 acres  
Prioritize room for vegetation to support wildlife and bird species  
Increase vegetation to support streambank stability and stream function |
| Floodplain (and water quality) | 356 acres of 100-Year FEMA Flood Zone (47% of 200’ Influence Zone)  
210 acres of 500-Year FEMA Flood Zone (27% of 200’ Influence Zone) | Contribute to the function of the floodplain through prioritized space for floodwaters, flood velocity and temporary storage  
Improve stormwater management and water quality through increased trapping of pollutants across pervious surface and more effectively capturing and filtering runoff to the river  
Increase recharge ground water through reduced impervious pavement |
The South Platte River corridor is home to over 25 parks within 200’ of the river’s edge. Parks and open space are connected by a vast network of sidewalks, trails, and bike lanes that weave through strips of green space along the river’s edge. Space along the South Platte River corridor is a valuable resource which provides mobility and recreational options for people of all ages and abilities. The corridor should be a safe space day and night to remain an attractive transportation option in Denver’s toolkit for moving people.

Access to parks and the river itself should be equitably distributed throughout all 18 neighborhoods along the corridor. However, barriers including railroads, highways, large industrial parcels, and infrequent bridge crossings in some neighborhoods prevent residents from accessing the river or enjoying recreational opportunities.
ACCESS & MOBILITY ALONG THE RIVER

The South Platte River Trail provides excellent mobility options along its 12.9 miles and 76 access points. However, these access points are not evenly dispersed throughout the South Platte River corridor, resulting in poor access in some neighborhoods. Based on the South Platte River Corridor Needs Assessment (2022), trail widths were found to vary between 6' and 24’, with the majority between 8’ and 12’. The South Platte River Corridor Needs Assessment (2022) also researched trail conditions for the length of the corridor and were scaled with the following results: 59% in good condition, 37% in fair condition, and 4% in poor condition.

A 200’ Influence Zone creates the opportunity to improve the design and functionality of trails, access to the river, and sidewalks. Additionally, the Influence Zone would create potential to rethink street function, minimize impervious surface and even transform streets into green space.

### Miles of Transportation Facilities

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>In 200’</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Platte River Trail</td>
<td>12.9 miles</td>
</tr>
<tr>
<td>South Platte River Trail Access Points</td>
<td>76 points</td>
</tr>
<tr>
<td>Sidewalks</td>
<td>27.3 miles</td>
</tr>
<tr>
<td>Trails (Paved &amp; Unpaved)</td>
<td>22.9 miles</td>
</tr>
</tbody>
</table>

### Acres of Parks & Open Space

<table>
<thead>
<tr>
<th>Amenity</th>
<th>in 200’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of City Parks</td>
<td>25 parks</td>
</tr>
<tr>
<td>Acres of Parks &amp; Open Space</td>
<td>120 acres</td>
</tr>
</tbody>
</table>

Figure 30.

Figure 31.
Active transportation facilities within each Character Area provide different mobility opportunities, comfort levels and local connectivity options. Increasing access to active transportation facilities within the 150’ Health & Access Area is key to utilizing the corridor’s large collection of parks and recreational facilities.

**The North**

Mobility in the North Character Area is increasing with improvements to the South Platte River Trail and Globeville Levee, the Arkins Promenade and other improvements through RiNo. The North Character Area is also home to a handful of parks including Argo Park, Carpio Sanguinette Park, and Globeville Landing Park. Limited trail ingress/egress presents challenges to access, comfort and safety. The 150’ Health & Access Area will enable prioritization of formal, publicly accessible connections to the South Platte River.

**Downtown**

Within The Downtown Character Area, The South Platte River Trail runs along both sides of the river and access to trails from adjacent land uses is plentiful. River recreational opportunities include fishing hotspots and whitewater features. Commons Park activates a long stretch of the river and has excellent trail coverage making The Downtown Character Area a unique Character Area for recreation.

Figure 32. North Character Area Mobility & Recreation Map

Figure 33. Downtown Character Area Mobility & Recreation Map
CHARACTER AREAS

Mid-City

The Mid-City Character Area is home to Vanderbilt Park, Valverde Park, Frog Hollow Park, Phil Milstien Park, and the recently renovated Johnson-Habitat Park. The South Platte River Trail extends along the west side of the river, but industrial uses minimize visibility of the trail and access points, especially south of 6th Avenue between the river and I-25. The 150’ Health & Access Area will allow for connectivity improvements to the trail and will increase access to recreational facilities along the South Platte River corridor.

The South

The South Character Area has some of the largest and most densely programmed parks including Ruby Hill Park, the Overland Golf Course, and Grant Frontier Park. The South Platte River Trail has numerous access points, however they are mainly clustered around park locations. The 150’ Health & Access Area will prioritize more frequent and visible connections to trails and create the potential to increase utilization of park facilities.

Figure 34. Mid-City Character Area Mobility & Recreation Map

Figure 35. South Character Area Mobility & Recreation Map
## Conditions Evaluated

### South Platte River corridor Mobility and Access

- **22.9** miles of existing paved and unpaved trails, including **12.9** miles of the South Platte River Trail
- **27.3** miles of sidewalks
- **76** access points to the South Platte River Trail
- **49** bridges (25 vehicular, 13 pedestrian-only, 11 rail-only)

### Public Right-of-Way

- **142** acres of public right-of-way (26% of the 200’ Influence Zone)

### Parks and Open Space

- **120** acres of parks (25 parks in the 200’ Influence Zone)

## Findings in 200’ Influence Zone

### South Platte River corridor Mobility and Access

- Improve trails and trail connections and strengthen the South Platte River corridor for future mobility needs
- Increase formal public access points along the South Platte River corridor to improve public access opportunities.
- Prioritize and ensure an interconnected mobility network as part of the South Platte River corridor

### Public Right-of-Way

- Potentially repurpose city-owned existing street right of way and related impervious surfaces for increased multi-modal capacity and vegetated zone
- Influence future planning efforts of other public agencies
- More effectively capture and filter runoff to the river and recharge ground water through reduced impervious pavement

### Parks and Open Space

- Increase natural habitat and open space conditions along the river corridor
- Increase publicly accessible parks and open space conducive to social interaction, placemaking and healthy living
Land use and the built environment play a significant role in how the community interacts with the river. The historically industrial influence acts as a barrier to river access, impeding human scale activity along the South Platte River. The land use pattern positions the river as a “back door” to the community in most locations. Instead, the South Platte River corridor should embrace adjacent neighborhoods in a way that reflects their history, culture and identity.

As redevelopment occurs along the corridor, an emphasis on prioritizing the HRCS Goals and Objectives within the 200' Influence Zone can significantly alter the river’s edge, minimize the effects of land use barriers and establish a more diverse and vibrant human-scale environment.
Land Use Composition

The top five most prevalent land uses make up the majority of land within the 50’ Riparian Priority Area along the South Platte River corridor (shown in black bars). Many of these uses such as railroads, industrial uses, vacant land, and right-of-way are comprised of impervious surfaces and are not the most compatible uses in achieving a healthy upland riparian zone. The 50’ Riparian Priority Area has the opportunity to positively shape the river’s edge by recommending land uses that would be more compatible along the river’s edge.

Acreages drastically increase within the next 150’ Health & Access Area for all land uses. A greater variety of uses are found here, presenting an opportunity to create a stronger sense of place and allowing residents to experience the South Platte River corridor in different ways.

Parcel Ownership

The ownership of parcels within the 200’ Influence Zone play a significant role in the potential to transform the land use pattern and ensure public access to the South Platte River. The opportunity to influence building pattern, right-of-way treatments and impervious surface coverage is significant with public agencies holding 63% of land, between parcels and right-of-way ownership. Private parcel redevelopment should be aligned with the HRCS Goals and Objectives.

<table>
<thead>
<tr>
<th>Ownership Type</th>
<th>Acres</th>
<th>%</th>
<th>Ownership Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Parcels</td>
<td>196</td>
<td>37%</td>
<td>37% Private</td>
</tr>
<tr>
<td>Public Parcels</td>
<td>194</td>
<td>36%</td>
<td>63% Public</td>
</tr>
<tr>
<td>Public Right-of-Way</td>
<td>142</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>200’ Influence Zone Total</td>
<td>532</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Figure 38 - Note: A total of 547 acres of space exists within the 200’ Influence Zone. However, only 532 acres were accounted for within parcel and right-of-way GIS open data, resulting in roughly 15 acres of land not falling under any ownership type.
LAND USE BY CHARACTER AREA

Understanding the existing composition of land uses within each Character Area is essential in order to achieve the HRCS Goals & Objectives. Land uses should complement the identity of each Character Area within the 200' Influence Zone.

The North

North of I-70, The North Character Area is primarily industrial, although Carpio Sanguinette Park occupies a large swath of land on the west side of the river and railroads occupy a large band of land on the east side of the river. However, these railroads will soon be redeveloped into park land as part of improvements to the river’s edge through the National Western Center. South of I-70, industrial uses continue to occupy the 200’ Influence Zone on the west side of the river, but a more diverse mix of land uses can been seen on the east side of the river in the Five Points Neighborhood. These mixed use developments begin to create a stronger opportunity for community interaction with the South Platte River.

Downtown

The Downtown Character Area has the highest concentration of recreational and entertainment/cultural use along the South Platte River corridor. The Denver Aquarium, Children's Museum, and Elitch Gardens (to eventually become the River Mile mixed use development) are surrounded by ample park space. However, railroads and vacant land occupy a relatively large area of land to the north near Park Ave and industrial uses pick up again towards Colfax Ave near the southern border of this character area. Overall, the land use pattern and lack of building footprint within the 200’ Influence Zone, allows for recreational improvements and human interaction, to support a more vibrant and activated river’s edge.

Figure 39. North Character Area Land Use Map

Figure 40. Downtown Character Area Land Use Map
CHARACTER AREAS

Mid-City
The Mid-City Character Area extends through a highly industrial area of the city with manufacturing, surface parking and right of way occupying the majority of space within the 200’ Influence Zone. The eastern edge of the river is flanked by I-25 resulting in little room for opportunity beyond the initial 50’ Riparian Priority Area.

More suitable land uses include a band of orange multi-unit residential in the Sun Valley neighborhood and park space in the Athmar Park Neighborhood.

The South
The South Character Area is home to 34 acres of parks & open space that lie within the 200’ Influence Zone; the most of any Character Area. While these parks are large, some of them poorly interface with the river’s edge including Ruby Hill Park which is separated from the river by a band of railroads and the Overland Gold Course which is fenced off from the river. Other parks have better relationships, including Grant-Frontier Park which provides excellent access to the river and visually showcases the active channel.

It should also be noted that South Platte River Drive runs along both sides of the river throughout the majority of this character area which provides access. However, its paved impermeable surface is too close to the river’s upland area making it an incompatible land use within the 200’ Influence Zone.
Urban areas experience warmer temperatures as a result of a large building footprints, high emissions, and heat absorbing surfaces such as black roofs and parking lots. On average, these urban heat islands (UHI) will range from 2–22 degrees Fahrenheit warmer than adjacent rural areas.

Generally, plants create cooler ambient temperatures than impervious surfaces because of their reflective properties, evapotranspiration, and shading. Waterways or “urban blue space” in the scientific literature, have been found to significantly reduce average summer temperatures in the northern hemisphere (Volker et al 2013).

For more about urban heat island effects across the United States, visit The Trust For Public Land’s interactive web map.

Above Average Temperatures in Denver

- **Mild Heat**
- **Severe Heat**
The urban heat island effect is minimal within the initial 50' Riparian Priority Area due to the cooling effects of the river and vegetation. Temperatures rise further away from the river in the 150' Health & Access Area where more urbanized surfaces attract heat. This is especially true in the industrial North Character Area.

**The North**

The North Character Area has the highest acreage of mapped urban heat island within the 200' Influence Zone. Nine acres of urban heat island are within the 50' Riparian Priority Area and an additional 26 acres are within the next 150' Health & Access Area. The majority of these elevated temperatures are located on the west side of the river in Globeville and south of Globeville where there is excessive pavement attached to industrial uses.

**Downtown**

The Downtown Character Area Riverfront development is set back further from the river and there is greater green or natural space along the river. Spaces such as Gates Crescent, Fishback Park, Confluence Park and City of Cuernavaca Parks provide cooling shade and evapotranspiration. Due to the concentration of these parks, The Downtown Character Area only has three acres of urban heat island within the 50' Riparian Priority Area and an additional nine acres within the 150' Health and Access Area.
**Mid-City**

The Mid-City Character Area only has two acres of urban heat island in the 50’ Riparian Priority Area, although it has the second highest acreage of elevated temperatures (21 acres) within the 150’ Health & Access Area. The majority of the urban heat island occupies the west side of the river in Sun Valley and Valverde where industrial uses and pavement attract heat.

**The South**

The South Character Area is the only Character Area with no heat island within the 50’ Riparian Priority Area. The extensive greenspaces along the corridor, such as Overland Golf Course, protects and retains the cooling effect of the river. The riverfront industrial development in the College View neighborhood is also less dense and less paved resulting in only two acres of urban heat island in the 150’ Health & Access Area.
# Land Use | Key Takeaways

<table>
<thead>
<tr>
<th>Conditions Evaluated</th>
<th>Findings in 200’ Influence Zone</th>
<th>Potential Opportunities of a 200’ Influence Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parcel Ownership</strong></td>
<td>196 acres of private parcels; 194 acres of public parcels; 142 acres of public right-of-way</td>
<td>Influence private and public parcel redevelopment and interface at river’s edge</td>
</tr>
<tr>
<td></td>
<td>37% private / 63% public split</td>
<td>Influence site design, building footprint and parking surfaces to reduce impervious surface and increase vegetation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Activate the river’s edge through supporting land use patterns</td>
</tr>
<tr>
<td><strong>Land Use Mix and Public Realm</strong></td>
<td>1.7% Residential 2.7% Entertainment / Cultural 3.1% Surface Parking 3.5% Office 3.7% Commercial or Mixed Use 5.7% Utilities &amp; Railroads 7.5% Vacant Land 19.2% Industrial 24.3% Parks &amp; Open Space 28.8% Right-of-Way</td>
<td>Activate riverfront with river-oriented development and related guidelines for setbacks, density, mix of uses, income and affordable housing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase public access through public and private redevelopment and to influence the public realm along the South Platte River for all residents</td>
</tr>
<tr>
<td><strong>Neighborhood Equity and Culture</strong></td>
<td>18 distinct neighborhoods adjacent to the South Platte River</td>
<td>Prioritize neighborhood identity along the South Platte River corridor, develop cultural or artistic elements reflective of adjacent neighborhoods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Establish space for wayfinding, signage or public space through engagement and inclusion</td>
</tr>
<tr>
<td><strong>Urban Heat Island</strong></td>
<td>72 acres of urban heat island (13% of the 200’ Influence Zone)</td>
<td>Expand tree canopy along the South Platte River corridor in priority locations (e.g. based on community needs and compatibility with other floodplain considerations.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convert hotter, impervious surfaces to natural vegetation</td>
</tr>
</tbody>
</table>
ECONOMIC BENEFITS OF A HEALTHY RIVER CORRIDOR
SOUTH PLATTE RIVER ECONOMIC BENEFITS ASSESSMENT

Economic and Planning Systems (EPS) conducted a 2022 study to quantify the future economic benefits of enhancing the South Platte River corridor through improvement of recreational amenities and preservation of ecological health. The findings suggest health benefits, emissions reductions, and vehicle cost reductions would result in a benefit of $6.5 million over the next 40 years.

The study provided three baseline monetary benefits associated with preserving the South Platte River corridor. However, its purpose is equally to provide guidance on the additional long-term benefits that extend beyond the scope of the study. The factors presented are intended to showcase selected examples of a broad set of benefits that would result from improvements to the South Platte River corridor.

Methodology and Analysis

The benefits assessment consists of three major components: health, environmental, and vehicle use. Inputs for the assessment were sourced from Denver Open Data, DRCOG Regional Data Catalog, USDOT Benefit Cost Analysis Guidance, i-Tree Modeling Tool, the World Health Organization and the EPA. All factors were assessed over a 40-year period to capture tree life cycles and future climate impacts. These figures were discounted to 2023 present value at 7% annually (2% for CO₂ emissions) to reflect time value of money and greenhouse gas atmospheric persistence. See Appendix C for the full benefits assessment report.

Inputs and Assumptions

The corridor includes a multi-use path that extends the full length of the river within the City and County of Denver, which aligns with the City’s ridership data that drives the model. The corridor attracts pedestrians and cyclists, the composition of which includes 64% cyclists and 36% pedestrians. Of the cyclists, 47% of trips are for employment/errands and 53% are for recreation.

Trip counter data from Denver Open Data was analyzed to estimate increases in use that would potentially result from improvements to recreational infrastructure. This was used as a key assumption in the benefits assessment model, as the recreational improvements and the resulting additional use was a major input in calculating health and vehicle savings.

According to Denver trail use data, the South Platte River Trail segments with improved cycling and pedestrian infrastructure, amenities, and connectivity saw a 10% increase in annual average daily use relative to other portions of the trail.
MODE SHIFT

Decrease in Vehicle Cost
The share of additional trips categorized as utility trips were applied to the modeshift vehicle reduction portion of the model. Vehicle cost reductions were calculated on a per-mile basis using IRS mileage factors. Over a 40-year period with a 7% annual discount rate, this amounted to approximately $540,000 in benefits.

Emissions Abatement
Emissions abatement was calculated using EPA emissions-per-mile and cost-per-ton standards. Rather than using the EPA’s social cost of carbon recommendation from a 2015 estimate, this study used the figure ($190 per metric ton) presented by the EPA in 2022. Total benefits over the 40-year horizon at a 7% annual discount rate (2% for CO₂) amounted to approximately $170,000.

HEALTH

Unlike mode-shift-based benefits, use of the trail for all purposes improve users’ health. According to the World Health Organization, each cycle or walking trip reduces long term health expenditures and mortality risk. With hundreds of active transportation trips along the trail daily, these figures add to substantial savings in Denver’s public health.

Estimates applied to active transportation factors per mile were $6.31 for walking and $7.08 for cycling.

TREE ECOLOGY AND CARBON CAPTURE
The planting density assumptions call for ten additional trees per acre within the 200’ Influence Zone. This equated to slightly over 5,000 trees planted. Environmental benefits included several factors including CO₂ Sequestered, Avoided Runoff, NO₂, SO₂, and PM₂.₅ intercepted.
FULL SCOPE OF BENEFITS

While the focus of this analysis has been limited to three cases, there are a wide range of additional factors that could be quantified. The analysis should be considered preliminary in its scope and effort, recognizing that future work may be more comprehensive. Thus, the findings at this stage are conservative.

For example, factors analyzed in this study have unmeasured secondary benefits. Protecting and improving the riparian habitat would have a compounding effect on water quality, air quality, energy, and ecology. According to the model findings, planting ten additional trees per acre within the Influence Zone would directly remove approximately $1.1M of greenhouse gases and harmful pollutants from Denver’s air. However, tree planting would also result in many secondary benefits, such as reducing urban heat island temperatures which reduces energy costs and protects the health of human and ecological communities. Additionally, tree planting creates new habitats for local species and improves stormwater management by reducing runoff. These environmental conditions are not only interdependent and compounding, but also have strong implications for public health in the Denver Metro Area.

In addition to benefits related to the health of the environment and the public, future development patterns along the corridor would have significant economic impacts. An activated riverfront would stimulate the City’s economy through several major mechanisms. Commercial and retail activity along the corridor would stimulate the local economy and create jobs, compounded by mode-shift savings of trail users. Additionally, residential properties near the trail may see improvements in value, as seen in case studies and property resales records for many studies for properties located in close proximity to trails and open space.

Overall, the findings shed light on the potential benefits of leveraging one of the many opportunities along the South Platte River corridor in terms of environmental health, land use, public health, and equity. While improving trail infrastructure alone would result in a $6.5 million benefit, land use and development patterns, guiding strategies, and environmental policy will drastically shape the future of the corridor and Denver’s health and economy at large.
IMPLEMENTATION

The South Platte River is a critical regional asset that should be restored, protected, enhanced and celebrated. The urban river corridor should provide a healthy ecological environment, open space, recreation and public access to opportunities for residents and visitors. While improvements to the river and trail system have been made in some locations in recent years, the river corridor, as a whole, remains ecologically challenged and physically constrained, limiting the possibilities for transformation.

Today, oversight of the South Platte River is held by the City and County of Denver, Denver Water and Mile High Flood District. Strengthening collaboration between these entities and aligning land use, transportation, recreation and water planning practices is essential to achieving a healthy river corridor. Collaboration through the One Water Leaders (OWL) established under the Denver One Water Plan coupled with the direction provided through the Healthy River Corridor Study, are the basis for cohesive implementation strategy for the river corridor that can minimize the impact of changing political leadership or competing city priorities, enabling the river to remain a top priority for the City.

This section describes the recommended near-term next steps that will move the City forward toward achieving a healthy river corridor in 2023. It also identifies a range of implementation strategies that should be further explored as part of a comprehensive program for implementing a healthy river corridor over time.

Next Steps

The following item is the recommended near-term action

- **Site-Specific Narrative**

The following strategy should be considered a tool for successful on-going implementation.

- **Design Standards & Guidelines and Overlay Zone District**
NEXT STEP:
SITE-SPECIFIC NARRATIVE

The HRCS Goals and Objectives will best be implemented through regulatory changes, such as design standards & guidelines and/or a design overlay in the Denver Zoning Code, which are explained in the next section. It will take time to create these regulatory tools. Until regulatory tools are adopted, the City should establish an interim process to analyze development and redevelopment for all sites within the Influence Zone. Applicants developing larger sites that touch the Influence Zone should prepare a site-specific “narrative” to describe the relationship of their proposed project to the HRCS Goals and Objectives. The intent is to make applicants aware of the HRCS Goals and Objectives and achieve better design outcomes along the river.

The site-specific narrative would likely occur as part of concept site development plan submittals associated with larger sites. The narrative should succinctly describe how the proposed development satisfies HRCS Goals and Objectives and additional goals and objectives in any applicable area plan, and address the following key relationships between the river and the characteristics of the site and proposed development:

- Building footprint locations.
- Ground floor uses.
- Height and mass distribution.
- Location of open space.
- Vegetation form and function. Native or climate-adapted vegetation is encouraged.
- Green infrastructure location and type.
- Pervious / impervious surface cover.

Inviting, public access from public ways, circulation and recreational use within the Influence Zone, including:
- Locations;
- Hours;
- Wayfinding;
- Uses (active and passive recreation);
- Users (multi-modal connections, trails and accessibility)

Note that any future area plans that include portions of the Influence Zone should consider the characteristics listed above and whether additional characteristics should be considered within the area covered by the area plan.
SUPPORTING STRATEGY:
DESIGN ST ANDARDS & GUIDELINES AND OVERLAY ZONE DISTRICTS

The city should adopt new rules and regulations, likely in the form of South Platte River corridor Design Standards & Guidelines (DSG) to be co-adopted by CPD, DOTI and DPR, to guide development along the river. The DSG should apply to all development and redevelopment within the Influence Zone.

The intent of the DSG is to shape development that protects and enhances the river corridor and ensures achievement of the HRCS Goals and Objectives, confirmed through the Healthy River Corridor Policy Statement. DSG would address access, mobility, public realm, recreation, public health, resiliency and the interface between the river and adjacent development. The DSG will promote best practices in landscape and riverfront design for natural to urban contexts.

Proposed projects within the Influence Zone would be required to follow the South Platte River corridor DSG. Proposed development would demonstrate how it meets HRCS Goals and Objectives.

The DSG will be a well-crafted document that is developed with involvement of stakeholders and is administered consistently by the City with equitable and consistent interpretation and implementation. DSG are adopted by City departments as rules and regulations according to procedures in the Denver Revised Municipal Code.

Development of the South Platte River corridor DSG could include concurrent zoning updates, such as establishment of a design overlay zone district in the Denver Zoning Code, also referred to as an overlay zone or a design overlay. Zoning and DSG often work together in the same geographic area to advance design objectives. A design overlay reinforces the desired character for developing or redeveloping an area, such as the South Platte River. The overlay adjusts specific zoning standards for the underlying zoning on the site. A design overlay could work in conjunction with the South Platte River corridor DSG to create design outcomes that align with HRCS Goals and Objectives.

A design overlay best addresses zoning items such as maximum heights, minimum setbacks, parking requirements or exceptions and open space requirements. DSG can also address more specific site design elements such as mass, scale, architectural articulation, landscape and site design, and river connectivity. Denver Zoning Code Section 9.4.5 outlines the design overlay tool and the existing design overlay districts in use today. Design overlays are adopted by City Council through ordinance as an amendment to the Denver Zoning Code.

The Chicago River Design Guidelines
The Chicago River Design Guidelines outline expectations for development along The Chicago River and its waterway branches. The guidelines outline unique criteria for six character zones based on their existing context, scale and character. The design criteria establish expectations for architectural treatments, building design, fencing, lighting, landscape, materials, publicly accessible amenities, and riverbank treatments.

Click to Visit: Chicago's River Design Guidelines Webpage
Colorado Springs passed its first Streamside Ordinance in 2002 to regulate and protect its waterways from increasing development pressures. The ordinance was then followed by Streamside Design Guidelines (SDG) in 2003, and revised in 2009 as seen in the image to the right. The SDG is not intended to reduce or prohibit development along streams, but rather aims to arrange development in a fashion that is compatible with natural stream characteristics.

The SDG applies to any parcel that lies completely, or partially, within the Streamside Overlay (SS) zone district. The SS zone district applies to all waterways which are categorized into three typologies according to stream width:

1. Type 1 Waterways: Less than 25' Channel (70' Buffer)
2. Type 2 Waterways: Between 25' – 75' Channel (90' Buffer)
3. Type 3 Waterways: Greater than 75' Channel (120' Buffer)

The SDG provides requirements and guidance to help ensure that project designs utilize adjacent streams as amenities, preserve the streamside character and helps to advance better stream area interaction. Review criteria within the Streamside Ordinance must be satisfied in addition to standard development plan review criteria.

The SDG outlines the following 11 review criteria:

1. **Grading and Landform**: Changes to natural landform and grading limitations
2. **Site Design**: Incorporation of stream ecosystem and natural streamside setting; site plan and amenity integration with stream
3. **Wildlife Habitat Preservation**: Minimized impact upon wildlife habitat and the riparian ecosystem
4. **Trails and Recreation**: Incorporation of trail networks and other recreational opportunities
5. **Floodplain**: Protection of property and accommodation of flood storage and conveyance
6. **Significant Natural Features**: Identification and minimization of impact on natural features
7. **Complementary Plans**: Implementation of recommendations in relevant, approved subarea plans
8. **Riparian Buffers and Impervious Surfaces**: Implementation of riparian buffer, exclusion of impervious surface from the inner buffer zone, stormwater Best Management Practices (BMPs)
9. **Landscape**: Revegetation of disturbed areas, riparian plant communities
10. **Stream Bank Stabilization**: Minimization of disturbance to stream bank and slope
11. **Stream Reclamation**: Identification of opportunities to reclaim drainage way visually, functionally, or recreationally.

For a full description of the Colorado Springs Streamside Design Guidelines visit: Colorado Springs Streamside Overlay Webpage
APPENDIX A

APPENDIX:
RIVER PROTECTION ZONE PRECEDENTS
This appendix presents a summary of the precedents for urban river protection that were reviewed in the preparation of The Healthy River Corridor Study, Denver, 2023 (HRCS). 24 precedent examples were explored for their precedent value and lessons learned that might be applied to the HRCS.

The purpose of this precedent review was to identify the range of tools that have been recommended or adopted for the protection of urban rivers. The precedents cover a wide range of preservation objectives. Some are based in flood protection of urban properties. Some are intended to give room to river corridors to allow re-establishment of riparian ecologies, and others focus on urban design relationships of the built environment to waterways.

A variety of tools are also represented in the precedents. These range from simple prescriptive setbacks of land uses from river edges or flow conditions, while others are elaborate zoning overlays with design and development review, design standards and guidelines, and/or requirements for master planning on larger parcels.

The most complete and elaborate precedents are the result of numerous, sequential studies of the riverine and urban conditions along a waterway corridor. Typically, these precedents include a river corridor hydraulic analysis, ecosystem analysis, urban land use and transportation analysis, followed by public outreach, and establishment of design principles leading to a river corridor master plan. River specific overlay zones, corridor setbacks, design standards and guidelines and subsequent submittal, review and permitting procedures are a common result.

SEVEN KEY PRECEDENTS
Seven of the precedents reviewed present an overview of the range of tools and techniques that were deemed relevant to the HRCS. Each of these are presented below, with a summary that identifies that core tools and lessons learned. These were reviewed with the HRCS planning team, leading to the specific proposed corridor recommendations in the HRCS.

ADDITIONAL PRECEDENTS
Numerous additional precedents are included following the seven relevant precedents. These are not summarized but are attached as a record of the work performed and for easy access and review by interested parties.
This study is a summary overview of literature and research findings conducted by the Environmental Finance Center of the University of Maryland. The report investigates how riparian buffers are valued. The key lesson for the HRCS is a categorization of the complete range of riparian buffer functions that contribute to their value to the environment and/or community, paired with the public benefits associated with those functions. This classification system forms a reasonable framework for discussion of which functions and benefits are relevant to the HRCS, and was a basis for discussion of which tools to recommend for the Denver example.
The City of Boise adopted this code to establish a Boise River System Management District. The ordinance is based in four primary goals: 1) Flood Protection, 2) Fish and Wildlife, 3) Recreation and 4) Development opportunities. The system is based on FEMA mapping of a 100 year floodplain, defined as a flood of 6500 cfs. The ordinance establishes three classifications of land and water. These are mapped on official maps as Classes A, B and C. The classifications are based in the Boise River Fish and Wildlife Habitat Study, 1983, which classifies lands as: Class A (Extremely Important for Preservation); Class B (Moderately Important for Preservation; and Class C (lands within the 100 year floodplain not identified for preservation).

Class A lands are limited to 18 interventions or uses, such as water control structures, habitat restoration and similar elements that are deemed compatible with preservation. Class A lands are also supported with a range of standards that limit or define how specific activities (example: vegetation management or removal) can be conducted.

Class B lands are allowed to contain a wider range of uses, including agriculture and gravel operations. Standards are included for the review and approval of all uses and operations within Class B lands.

Class C lands allow a wide range of uses and operations, provided that habitat or other environmental enhancements are included, with provisions for submittal and review of plans.

The ordinance additionally establishes Greenbelt Setback Lands and Waters and a minimum setback for all structures, driveways, manicured landscapes and parking areas, of 70 feet from the established 6500 cfs mapped line. Provisions are included for field verification and site review to refine mapped lines with site conditions.
This By-Law is internal city departmental policy that establishes setbacks based on the stream classification. The classifications are based in stream order, or the position within a waterway system.

1st Order streams are those that are "typically a vegetated 'draw' that conveys flow primarily during periods of moderate to heavy rainfall and may not convey flow during other periods".

2nd Order streams are those that are "formed when two 1st order streams meet”.

3rd Order streams are those that are formed as "tributary of two 2nd order streams”.

4th Order streams are those that are formed as "tributary of two 3rd order streams”.

For example, the Bow River, Calgary's major river that is associated with a vast mountain watershed, is a 4th order stream.

Setbacks are defined for each stream order, and can be modified based on the slope, vegetation cover type, and hydraulic connectivity of lands within the setback zone. Such modifications are reviewed on a case-by-case, site verified conditions. The setbacks are justified on social, environmental and economic objectives. The setbacks are for all permanent structures and are defined as:

1st Order Stream: Setback 6 meters
2nd Order Stream: Setback 30 meters
3rd Order Stream: Setback 50 meters
4th Order Stream: Setback 50 meters
These guidelines are the implementation tool resulting from the 1999 Chicago River Corridor Development Plan. The primary, and impactful tool included in the guidelines is the provision that any development parcel, where any portion of the parcel lies within 100 feet of Chicago waterways must be processed as a Planned Development. The guidelines are the basis for the preparation of the Planned Development. This means that, effectively, parcels within 100 feet of the river are approved in semi-custom zoning that is designed to influence every aspect of the development to support the goals and objects of the guidelines. For large property owners this creates an incentive for creative, river-oriented planning; for small property owners it may increase the cost and burden to get small, simpler developments approved. As in any Planned Development, there is a public process required followed by Planning Commission and City Council approval.

The guidelines are divided into six “character zones”, each of which has differing guidelines. Each character zone comes with a minimum setback of 30 feet from “top of bank” except one zone that requires 60 feet. The guidelines impact the river edge, pathways, vegetation, stormwater and other features within the setback, but are also supplemented with urban design guidelines for land uses outside, but adjacent to the setback zones.
The LA River Revitalization Master Plan of 2007 anticipated the development of an overlay zone district. The district is nominally 1/2 mile wide; however as finalized the district is mapped to specific site and area conditions, topography and other factors. The zone district requires administrative review of any development application with the district that includes "the erection, construction, addition to, or exterior structural alteration of any building or structure located within a River Improvement District". All applications for any modification or new development are routed through the city Planning Department for special review under the RIO.

The adopted ordinance identifies Screening/Fencing; Exterior Site Lighting and similar development features or activities with specific guidelines in the ordinance, however the RIO also directs the Planning Department to adopt additional design guidelines for development within the RIO. These guidelines, as currently adopted, include broad intent statements for staff use in review of applications. These guidelines address five objectives: 1) River Context, Visibility and Access in Building and Site Design; 2) High Quality, Attractive and Distinctive Architecture; 3) Access to and Awareness of the River and its Relationship to the Community; 4) Quantity and Appearance of Parking and Loading Areas; and 5) Public Right-of-Ways to Capture and Treat Stormwater.
The City of Portland adopted specific standards and guidelines for the South Willamette Waterfront, an area that is designated for high density mixed-use development. The ordinance establishes an overlay zone district that supplements the underlying zoning for the area. The overlay defines detailed submittal requirements for site planning, architecture, signs and other features within the district.

The ordinance also defines a setback buffer zone of 50 or 75 feet depending on local bank and setback slope conditions. A subset of the ordinance, the Riverfront High Density Residential Overlay Zone, identifies additional land uses that are not allowed under the base zoning, establishes new height and density limits, establishes design review for all development, and includes extensive design standards and guidelines.
The City of San Diego adopted this plan which is designed to pursue five over-arching principles for development of the river and adjacent lands: 1) Restore and Maintain a Healthy River System; 2) Unify Fragmented Lands and Habitats; 3) Create a Connected Continuum with a Sequence of Unique Places; 4) Reveal the River History; and 5) Re-Orient Development Toward the River.

The plan defines a River Influence Area with specific dimensions. The influence area includes the defined floodway, protected by a 35 foot (essentially) no-build zone on each side, and a 200 foot setback on each side of the river beyond the 35 foot setback. The plan includes specific land use and development standards and guidelines for public and quasi public enhancements such as trails, vegetation, furnishings, lighting and signs. It also provides guidelines for site planning, building location, orientation and massing, river access and other features.

As a supplement to the Community Plans along the length of the river the effective impact of the plan is public scrutiny in California’s open planning process. Each Community Plan is supported with a Community Planning Group with members appointed by the mayor. Applicants must seek a recommendation of approval from the local Community Planning Group prior to advancing to Planning Commission. This process, while the guidelines are advisory, actually gives the plan significant impact as each community group refers to the plan guidelines in review of each project.
Riparian Habitat Method

Riparian habitat areas in the Denver Waterway study were based on a recently completed Regional Conservation Assessment for The Nature Conservancy (Biohabitats, 2022 pending release). The study area included seven counties in the metropolitan Denver area: Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson.

**Habitat extent.** The basis of the riparian habitat mapping was high-resolution (2m) land cover data, developed from 2019 USDA National Agriculture Imagery Program (NAIP) imagery, which was computer processed to generate the land cover data at 2m resolution. Other data which were incorporated to capture man-made features such as roads and other impervious surfaces (from DRCOG, Colorado Department of Transportation [CDOT], individual counties, Open Street Map, and Microsoft building footprints); shrubland layer information from the National Land Cover Database (NLCD 2019); and Sentinel-2 Normalized Difference Water Index (2020) for additional waterbodies. Riparian/wetland areas was one of the four main habitat categories which were evaluated for the habitat quality assessment.

**Riparian Habitat Quality.** Five indicators were used to evaluate regional habitat based on regional data coverage. Three indicators were calculated for habitat patches: patch size, patch perimeter area ratio, and edge context. Two indicators used data inputs at the pixel (raster cell) level: site resiliency characteristics and recognized biodiversity based on an area-weighted sum. Each of the indicators were also assigned a weight (% in parentheses) prior to being summed. The data sources for Site Resiliency Characteristics were comprised of landscape diversity and local connectedness metrics from the Resilient Sites layer of TNC’s Resilient and Connected Network (RCN) (Anderson et al. 2019) analysis. Areas of Recognized Biodiversity were those with relatively high biodiversity importance based on a combination of inventory and monitoring data from state and federal agencies, the Colorado Natural Heritage Program, and The Nature Conservancy. This indicator was comprised of US Fish and Wildlife Service (USFWS) Critical Habitat, Colorado Parks and Wildlife (CPW) State Wildlife Action Plan (SWAP) Crucial Habitat, Colorado Natural Heritage Program (CNHP) Potential Conservation Areas and Network of Conservation Areas, CNHP Element Occurrences, and Recognized Biodiversity Value from TNC’s Resilient and Connected Network analysis. The table below provides the details of the scoring.

### Quality Scoring Table

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Multiplier</th>
<th>Low Score</th>
<th>High Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patch Size</td>
<td>40</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Natural Size by Habitat Type to 5 acres</td>
<td>1&lt;5 acres to 10 acres</td>
<td>2&gt;10 acres to 15 acres</td>
<td>3&gt;15 acres to 25 acres</td>
</tr>
<tr>
<td>Perimeter Area Ratio</td>
<td>20</td>
<td>Natural Breaks Tier 1</td>
<td>Natural Breaks Tier 2</td>
</tr>
<tr>
<td>Edge Context</td>
<td>20</td>
<td>Natural Breaks Tier 1</td>
<td>Natural Breaks Tier 2</td>
</tr>
<tr>
<td>Site Resiliency Characteristics</td>
<td>10</td>
<td>Below average</td>
<td>Average</td>
</tr>
<tr>
<td>Recognized Biodiversity</td>
<td>10</td>
<td>Outside combined layer</td>
<td>Inside combined layer</td>
</tr>
</tbody>
</table>
References:


USDA, 2019. National Agriculture Imagery Program (NAIP) imagery.

MEMORANDUM

To: OV Consulting
From: Andrew Knudtsen and Gray Warner, Economic and Planning Systems; EPS #223017
Subject: South Platte River Benefits Assessment
Date: December 23, 2022

Overview
This memorandum seeks to quantify the economic benefits of enhancing Denver’s South Platte River corridor through improvement of recreational amenities and preservation of ecological health. The findings suggest that these improvements would result in over half of a million dollars saved annually on average through health benefits, emissions reductions, and vehicle cost reductions. In today’s dollars, this adds to a present benefit of $6.5 million.

This assessment provides three baseline monetary benefits associated with preserving the South Platte River corridor. However, its purpose is equally to provide guidance on the additional long-term benefits that extend beyond the scope of the study. The factors presented are intended to highlight a limited set of a much broader set of benefits improvements to the South Platte corridor are projected to have on the health of humans, the economy, and the natural environment in the Denver region.

Methodology and Analysis
The benefits assessment consists of three major components: health, environmental, and vehicle use benefits. Inputs for the assessment were sourced from Denver Open Data, DRCOG Regional Data Catalog, USDOT Benefit Cost Analysis Guidance, i-Tree Modeling Tool, and the EPA. All factors were assessed over a 40-year period to capture tree life cycles and future climate impacts. These figures were discounted to 2023 present value at 7 percent annually (2 percent for CO₂ emissions) to reflect time value of money and greenhouse gas atmospheric persistence.
Section I: Inputs and Assumptions

The corridor includes a multi-use path that extends the full length of the river within the City and County of Denver and extends well beyond the city limits. The study area, however, is confined to the portion within the City and County of Denver, which aligns with the city’s ridership data that drives the model. The corridor attracts pedestrians and cyclists, the composition of which includes 64 percent cyclists and 36 percent pedestrians. Of the cyclists, 47 percent of trips are for employment/errands and 53 percent are for recreation. The research has been summarized below in Table 1.

Table 1. Summary of Factors

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trips by Length</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average cycle trip distance</td>
<td>3.4</td>
<td>miles</td>
<td>DRCOG</td>
</tr>
<tr>
<td>Average pedestrian trip distance</td>
<td>0.9</td>
<td>miles</td>
<td>DRCOG, WHO</td>
</tr>
<tr>
<td>Length of Study Area</td>
<td>9.6</td>
<td>miles</td>
<td>Denver Open Data</td>
</tr>
<tr>
<td>Trips by Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td>53%</td>
<td>share of trips</td>
<td>National Household Travel Survey</td>
</tr>
<tr>
<td>Errand/Other Utility</td>
<td>30%</td>
<td>share of trips</td>
<td>National Household Travel Survey</td>
</tr>
<tr>
<td>Commute</td>
<td>18%</td>
<td>share of trips</td>
<td>National Household Travel Survey</td>
</tr>
<tr>
<td>Trips by Mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian</td>
<td>36%</td>
<td>share of trips</td>
<td>Denver Open Data</td>
</tr>
<tr>
<td>Cyclist</td>
<td>64%</td>
<td>share of trips</td>
<td>Denver Open Data</td>
</tr>
<tr>
<td>Total AADT</td>
<td>780</td>
<td>trips</td>
<td>Denver Open Data</td>
</tr>
<tr>
<td>Growth Rates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Growth rate</td>
<td>3.2%</td>
<td>increase in trips</td>
<td>ACS 5-year '11-'20</td>
</tr>
<tr>
<td>1-year growth with improvements</td>
<td>13.2%</td>
<td>increase in trips</td>
<td>Denver Open Data</td>
</tr>
</tbody>
</table>

Table Source: Economic & Planning Systems

As shown in Table 2 below, trip counter data from Denver Open Data was analyzed to estimate increases in use that would potentially result from improvements to recreational infrastructure. This was used as a key assumption in the benefits assessment model, as the recreational improvements and the resulting additional use was a major input in calculating health and vehicle savings.

According to Denver trail use data, South Platte River trail segments with improved cycle and pedestrian infrastructure, amenities, and connectivity saw a 10 percent increase in annual averages of daily use relative to other portions of the trail. As many trail counters were not implemented until mid-2019, and 2022 had not completed a full calendar year at the time of this analysis, the best data for comparison are those collected during 2020 and 2021. These were compared in order to capture averages with complete seasonal cycles of trail use.
For these years, the corridor saw a spike in utilization during 2020, when COVID conditions were such that there was a greater presence in parks, trails, and open space. This contracted uniformly the following year, and the pandemic subsided, as shown below in the counter data in Table 2. What is more significant, as shown in the table, is that all trail segments with the exception of Counter 3 (located between 6th and Colfax Avenues) saw significant decreases in ridership from 2020 to 2021. This general decline is largely due to the subsidence of COVID. However, trail counter 3 saw no decrease in ridership; users returned to this trail segment at over 10 percent higher rates than other segments in 2021. A field inspection of these segments show that the highest quality of segment is closest to Counter 3, as noted in greater detail below.

**Table 2. Utilization of the Corridor**

<table>
<thead>
<tr>
<th>South Platte Trail</th>
<th>Counter AADT</th>
<th>2020</th>
<th>2021</th>
<th>2020-2021 Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counter 1</td>
<td>815</td>
<td>702</td>
<td></td>
<td>-113</td>
<td>-14%</td>
</tr>
<tr>
<td>Counter 2</td>
<td>628</td>
<td>567</td>
<td></td>
<td>-62</td>
<td>-10%</td>
</tr>
<tr>
<td>Counter 3</td>
<td>680</td>
<td>683</td>
<td></td>
<td>3</td>
<td>0%</td>
</tr>
<tr>
<td>Counter 4</td>
<td>990</td>
<td>882</td>
<td></td>
<td>-108</td>
<td>-11%</td>
</tr>
<tr>
<td>Counter 5</td>
<td>661</td>
<td>599</td>
<td></td>
<td>-62</td>
<td>-9%</td>
</tr>
<tr>
<td>Counter 6</td>
<td>297</td>
<td>263</td>
<td></td>
<td>-34</td>
<td>-12%</td>
</tr>
</tbody>
</table>

Source: Economic & Planning Systems, Denver Open Data

Thus, EPS conservatively applied a 10 percent rate of user increase to the model to reflect a build alternative that accounts for improving infrastructure for the trail in a similar manner. Regardless of the spike in ridership in 2020, trail counter 3 has outperformed other segments along the South Platte River trail by this margin. With recently improved trail infrastructure, this area of the trail draws more users than other areas. As shown to the right, the area near trail Counter 3 has a wider, newer concrete trail, a crusher fine detached pedestrian walkway, benches, trash receptacles, open space, and improved landscaping compared to all other trail segments.
From these inputs, increases in trips, increase in trail miles traveled, and trips and miles diverted were calculated. Annual average trips were compared between an improvement and no-improvement scenario to derive an annual change in trips that would occur upon improvement of trail infrastructure.

Table 3. Projected Increase in Utilization

<table>
<thead>
<tr>
<th>Project Year</th>
<th>Daily Trips</th>
<th>Annual Trips</th>
<th>Total Change in Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current</td>
<td>Alternative</td>
<td>Current</td>
</tr>
<tr>
<td>2024</td>
<td>858</td>
<td>941</td>
<td>313,050</td>
</tr>
<tr>
<td>2025</td>
<td>885</td>
<td>971</td>
<td>323,068</td>
</tr>
<tr>
<td>2026</td>
<td>913</td>
<td>1,002</td>
<td>333,406</td>
</tr>
<tr>
<td>2027</td>
<td>943</td>
<td>1,034</td>
<td>344,075</td>
</tr>
<tr>
<td>2028</td>
<td>973</td>
<td>1,067</td>
<td>355,086</td>
</tr>
<tr>
<td>2029</td>
<td>1,004</td>
<td>1,101</td>
<td>366,449</td>
</tr>
<tr>
<td>2030</td>
<td>1,036</td>
<td>1,136</td>
<td>378,175</td>
</tr>
<tr>
<td>2040</td>
<td>1,420</td>
<td>1,557</td>
<td>518,193</td>
</tr>
<tr>
<td>2050</td>
<td>1,945</td>
<td>2,134</td>
<td>710,053</td>
</tr>
<tr>
<td>2060</td>
<td>2,666</td>
<td>2,924</td>
<td>972,948</td>
</tr>
</tbody>
</table>

Source: Economic & Planning Systems, Denver Open Data, DRCOG

The total change in trips was then applied to shares of trips by type along the trail as per the inputs. As shown below in Table 4, the estimate of trips diverted applies only to non-recreation trips, as those are likely to be independent of trips that might otherwise occur using automobiles. The information calculates trips diverted from roadways based on the additional utilization of the corridor by cyclists.

Table 4. Projected Diversion of Trips

<table>
<thead>
<tr>
<th>Project Year</th>
<th>Total Change in Trips</th>
<th>Change in Trips by Type</th>
<th>Trips Diverted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Recreation</td>
<td>Commute</td>
</tr>
<tr>
<td>2024</td>
<td>30,334</td>
<td>15,925</td>
<td>5,308</td>
</tr>
<tr>
<td>2025</td>
<td>31,305</td>
<td>16,435</td>
<td>5,478</td>
</tr>
<tr>
<td>2026</td>
<td>32,307</td>
<td>16,961</td>
<td>5,654</td>
</tr>
<tr>
<td>2027</td>
<td>33,341</td>
<td>17,504</td>
<td>5,835</td>
</tr>
<tr>
<td>2028</td>
<td>34,408</td>
<td>18,064</td>
<td>6,021</td>
</tr>
<tr>
<td>2029</td>
<td>35,509</td>
<td>18,642</td>
<td>6,214</td>
</tr>
<tr>
<td>2030</td>
<td>36,645</td>
<td>19,239</td>
<td>6,413</td>
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<tr>
<td>2040</td>
<td>50,213</td>
<td>26,362</td>
<td>8,787</td>
</tr>
<tr>
<td>2050</td>
<td>68,804</td>
<td>36,122</td>
<td>12,041</td>
</tr>
<tr>
<td>2060</td>
<td>94,278</td>
<td>49,496</td>
<td>16,499</td>
</tr>
</tbody>
</table>

Source: Economic & Planning Systems, Denver Open Data, DRCOG
Next, mileages were applied as weighted averages of trip length by mode and purpose. Net change in miles of activity was the total increase in miles traveled along the trail, which served as the input for health benefits. The net miles diverted was the factor used in vehicle reduction benefits. Note that the economic value of these miles diverted is provided below.

### Table 5. Total Miles Diverted

<table>
<thead>
<tr>
<th>Project Year</th>
<th>Total Change in Trips</th>
<th>Trips Diverted</th>
<th>Total Change in Miles of Activity</th>
<th>Total Miles Diverted</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024</td>
<td>30,334</td>
<td>14,409</td>
<td>104,350</td>
<td>49,566</td>
</tr>
<tr>
<td>2025</td>
<td>31,305</td>
<td>14,870</td>
<td>107,689</td>
<td>51,152</td>
</tr>
<tr>
<td>2026</td>
<td>32,307</td>
<td>15,346</td>
<td>111,135</td>
<td>52,789</td>
</tr>
<tr>
<td>2027</td>
<td>33,341</td>
<td>15,837</td>
<td>114,692</td>
<td>54,479</td>
</tr>
<tr>
<td>2028</td>
<td>34,408</td>
<td>16,344</td>
<td>118,362</td>
<td>56,222</td>
</tr>
<tr>
<td>2029</td>
<td>35,509</td>
<td>16,867</td>
<td>122,149</td>
<td>58,021</td>
</tr>
<tr>
<td>2030</td>
<td>36,645</td>
<td>17,406</td>
<td>126,058</td>
<td>59,878</td>
</tr>
<tr>
<td>2040</td>
<td>50,213</td>
<td>23,851</td>
<td>172,731</td>
<td>82,047</td>
</tr>
<tr>
<td>2050</td>
<td>68,804</td>
<td>32,682</td>
<td>236,684</td>
<td>112,425</td>
</tr>
<tr>
<td>2060</td>
<td>94,278</td>
<td>44,782</td>
<td>324,316</td>
<td>154,050</td>
</tr>
<tr>
<td>2061</td>
<td>97,295</td>
<td>46,215</td>
<td>334,694</td>
<td>158,980</td>
</tr>
<tr>
<td>2062</td>
<td>100,408</td>
<td>47,694</td>
<td>345,404</td>
<td>164,067</td>
</tr>
</tbody>
</table>

Source: Economic & Planning Systems, Denver Open Data

### Section II: Value Derived from a Reduction in Automobile Usage

Assessing benefits of mode shift consisted of two components: reduction in vehicle costs and emissions abatement. Since recreational trips do not generally reduce vehicle use, only the share of utility trips included in the increase factor were applied to the vehicle reduction portion of the model. Vehicle cost reductions were calculated on a per-mile basis using IRS mileage factors. Over a 40-year period with a 7 percent annual discount rate, this amounted to approximately $540,000 in benefits.

### Table 6. Vehicle Cost Savings

<table>
<thead>
<tr>
<th>Project Year</th>
<th>Net Miles Diverted</th>
<th>Vehicle Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024</td>
<td>49,566</td>
<td>$28,996</td>
</tr>
<tr>
<td>2025</td>
<td>51,152</td>
<td>$29,924</td>
</tr>
<tr>
<td>2026</td>
<td>52,789</td>
<td>$30,882</td>
</tr>
<tr>
<td>2027</td>
<td>54,479</td>
<td>$31,870</td>
</tr>
<tr>
<td>2028</td>
<td>56,222</td>
<td>$32,890</td>
</tr>
<tr>
<td>2029</td>
<td>58,021</td>
<td>$33,942</td>
</tr>
<tr>
<td>2030</td>
<td>59,878</td>
<td>$35,028</td>
</tr>
<tr>
<td>2040</td>
<td>82,047</td>
<td>$47,998</td>
</tr>
<tr>
<td>2050</td>
<td>112,425</td>
<td>$65,769</td>
</tr>
<tr>
<td>2060</td>
<td>154,050</td>
<td>$90,119</td>
</tr>
</tbody>
</table>

**Annual Average** $54,059

Source: Economic & Planning Systems, IRS, Denver Open Data
Emissions abatement was calculated using EPA emissions-per-mile and cost-per-ton standards. Rather than using the EPA’s social cost of carbon recommendation from a 2015 estimate, EPS opted to use the figure ($190 per metric ton) presented by the EPA in 2022. Although this number will not be adopted by the agency until early 2023, this value was used to reflect current economic and climate conditions more accurately than the 2015 figure. The 2015 figures were used for all other emissions; no revisions have been provided by the agency on other pollutants. Total benefits over the 40-year horizon at a 7 percent annual discount rate amounted to approximately $170,000.

Table 7. Value Derived from Reduction in GHG and Related Pollutants

<table>
<thead>
<tr>
<th>Project Year</th>
<th>Net Miles Diverted</th>
<th>Annual Net Decrease in GHG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SOX</td>
<td>PM</td>
</tr>
<tr>
<td>2024</td>
<td>49,566</td>
<td>$9</td>
</tr>
<tr>
<td>2025</td>
<td>51,152</td>
<td>$9</td>
</tr>
<tr>
<td>2026</td>
<td>52,789</td>
<td>$9</td>
</tr>
<tr>
<td>2027</td>
<td>54,479</td>
<td>$10</td>
</tr>
<tr>
<td>2028</td>
<td>56,222</td>
<td>$10</td>
</tr>
<tr>
<td>2029</td>
<td>58,021</td>
<td>$10</td>
</tr>
<tr>
<td>2030</td>
<td>59,878</td>
<td>$11</td>
</tr>
<tr>
<td>2040</td>
<td>82,047</td>
<td>$14</td>
</tr>
<tr>
<td>2050</td>
<td>112,425</td>
<td>$20</td>
</tr>
<tr>
<td>2060</td>
<td>154,050</td>
<td>$27</td>
</tr>
<tr>
<td>Annual Average</td>
<td>$16</td>
<td>$92</td>
</tr>
</tbody>
</table>

Source: Economic & Planning Systems, EPA, Denver Open Data
Section III: Value derived from an increase in Health Benefits

Unlike mode-shift-based benefits, use of the trail for all purposes improve users’ health. According to the World Health Organization, each cycle or walking trip reduces long term health expenditures and mortality risk. With hundreds of active transportation trips along the trail daily, these figures add to substantial savings in Denver’s public health.

Active transportation health benefits were calculated by these standard practices set forth by the World Health Organization and USDOT’s Benefit-Cost Analysis Guidance. Additional trips were calculated using the aforementioned trail counts and projections with growth rates from ACS 5-year estimates with a one-time 10 percent increase. This 10 percent increase reflects the change in behavior triggered by an improvement in corridor quality and conditions.

These estimates were then applied to active transportation factors of $6.31 and $7.08 per mile for walking and cycling, respectively, and discounted to present value at a 7 percent rate as recommended by the USDOT. As a result, total health benefits over a 40-year period discounted at a 7 percent annual rate was approximately $4.7 million.

Table 8. Health Benefits

<table>
<thead>
<tr>
<th>Project Year</th>
<th>Total Change in Trips</th>
<th>Pedestrian Health Savings</th>
<th>Cyclist Health Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024</td>
<td>30,334</td>
<td>$76,377</td>
<td>$178,272</td>
</tr>
<tr>
<td>2025</td>
<td>31,305</td>
<td>$78,821</td>
<td>$183,977</td>
</tr>
<tr>
<td>2026</td>
<td>32,307</td>
<td>$81,343</td>
<td>$189,864</td>
</tr>
<tr>
<td>2027</td>
<td>33,341</td>
<td>$83,946</td>
<td>$195,940</td>
</tr>
<tr>
<td>2028</td>
<td>34,408</td>
<td>$86,632</td>
<td>$202,210</td>
</tr>
<tr>
<td>2029</td>
<td>35,509</td>
<td>$89,405</td>
<td>$208,681</td>
</tr>
<tr>
<td>2030</td>
<td>36,645</td>
<td>$92,265</td>
<td>$215,359</td>
</tr>
<tr>
<td>2040</td>
<td>50,213</td>
<td>$126,427</td>
<td>$295,094</td>
</tr>
<tr>
<td>2050</td>
<td>68,804</td>
<td>$173,236</td>
<td>$404,352</td>
</tr>
<tr>
<td>2060</td>
<td>94,278</td>
<td>$237,376</td>
<td>$554,063</td>
</tr>
<tr>
<td>Annual Average</td>
<td></td>
<td><strong>$142,393</strong></td>
<td><strong>$332,361</strong></td>
</tr>
</tbody>
</table>

Source: Economic & Planning Systems, USDOT, WHO, Denver Open Data
Section IV: Tree and Carbon Capture Benefits

Carbon sequestration benefits of planting trees were calculated in part by a planting model provided by i-Tree, an organization sponsored by the USDA Forest Service and the International Society of Arboriculture. Tree species were selected based on native species and a field survey, and numbers to plant were calculated on a per-acre basis. Cottonwood and boxelder were selected based on knowledge of native species as well as a field study surveying the species of trees along the river. The planting density assumptions call for 10 additional trees per acre within the 200’ zone of the river. This equated to slightly over 5,000 trees planted. Environmental benefits included several factors including CO2 Sequestered, Avoided Runoff, NO2, SO2, and PM2.5 sequestered. Resulting values are shown below in Table 9.

Table 9. Benefits Derived from Additional Trees

<table>
<thead>
<tr>
<th>Species</th>
<th>Cottonwood</th>
<th>Boxelder</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Planted</td>
<td>2,635</td>
<td>2,635</td>
<td>5,270</td>
</tr>
<tr>
<td>CO2 Sequestered</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pounds</td>
<td>12,679,957</td>
<td>9,446,396</td>
<td>22,126,353</td>
</tr>
<tr>
<td>Dollars</td>
<td>$294,897</td>
<td>$219,694</td>
<td>$514,591</td>
</tr>
<tr>
<td>Biomass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Tons</td>
<td>3,157</td>
<td>2,358</td>
<td>5,515</td>
</tr>
<tr>
<td>Rain Interception</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gallons</td>
<td>18,489,479</td>
<td>30,132,340</td>
<td>48,621,818</td>
</tr>
<tr>
<td>Avoided Runoff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gallons</td>
<td>4,394,690</td>
<td>7,162,033</td>
<td>11,556,723</td>
</tr>
<tr>
<td>Dollars</td>
<td>$39,271</td>
<td>$64,000</td>
<td>$103,271</td>
</tr>
<tr>
<td>NO2 Removed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pounds</td>
<td>4,580</td>
<td>7,739</td>
<td>12,319</td>
</tr>
<tr>
<td>Dollars</td>
<td>$16,639</td>
<td>$28,118</td>
<td>$44,757</td>
</tr>
<tr>
<td>SO2 Removed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pounds</td>
<td>490</td>
<td>819</td>
<td>1,310</td>
</tr>
<tr>
<td>Dollars</td>
<td>$10,524</td>
<td>$17,597</td>
<td>$28,122</td>
</tr>
<tr>
<td>PM2.5 Removed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pounds</td>
<td>899</td>
<td>1,552</td>
<td>2,451</td>
</tr>
<tr>
<td>Dollars</td>
<td>$149,339</td>
<td>$257,949</td>
<td>$407,288</td>
</tr>
<tr>
<td>Total Benefit</td>
<td>$510,670</td>
<td>$587,358</td>
<td>$1,098,029</td>
</tr>
</tbody>
</table>

Source: Economic & Planning Systems, i-Tree Planting
Conclusion

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree Ecology Benefits:</td>
<td>$1,098,029</td>
</tr>
<tr>
<td>Health Benefits:</td>
<td>$4,734,231</td>
</tr>
<tr>
<td>Mode Shift Benefits:</td>
<td>$709,069</td>
</tr>
<tr>
<td>Total Benefits:</td>
<td>$6,541,329</td>
</tr>
</tbody>
</table>

While the focus of this analysis has been limited to three cases, there are a wide range of additional factors that could be quantified. The analysis should be considered preliminary in its scope and effort, recognizing that future work may be more comprehensive. Thus, the findings at this stage are conservative.

For example, factors analyzed in this study have unmeasured secondary benefits. Protecting and improving the riparian habitat would have a compounding effect on water quality, air quality, energy, and ecology. According to the model findings, planting 10 additional trees per acre along the study area would directly remove approximately $1.1M of greenhouse gases and harmful pollutants from Denver’s air. However, tree planting would also result in many secondary benefits, such as reducing urban heat island temperatures which reduces energy costs and protects the health of human and ecological communities. Additionally, tree planting creates new habitats for local species and improves stormwater management by reducing runoff. These environmental conditions are not only interdependent and compounding, but also have strong implications for Denver metro’s public health.

In addition to benefits related to the health of the environment and the public, future development patterns along the corridor would have significant economic impacts. An activated riverfront would stimulate the City’s economy through several major mechanisms. Commercial and retail activity along the corridor would stimulate the local economy and create jobs, compounded by mode-shift savings of trail users. Additionally, residential properties near the trail may see improvements in value, as seen in case studies and property resales records for many studies for properties located in close proximity to trails and open space.

Overall, the findings shed light on the potential benefits of leveraging one of the many opportunities along the South Platte corridor in terms of environmental health, land use, public health, and equity. While improving trail infrastructure alone would result in a $6.5 million benefit, land use and development patterns, guiding strategies, and environmental policy will drastically shape the future of the corridor and Denver metro’s health and economy at large.