

The background of the cover features a stylized illustration of a river. The water is depicted in shades of light blue and teal, with numerous white arrows indicating the direction of flow. Several light brown, angular rocks are scattered throughout the riverbed. The overall aesthetic is clean and modern, with a focus on natural elements.

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Universal Angling Access Design Guide

Focused on the Denver South Platte River

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Purpose and need

This guide is intended to fill a knowledge gap for designers, engineers, and contractors so that river access points can be located near good fishing locations and can incorporate underwater habitat into their designs. By interviewing experts with years of experience working with our unique river we have assembled ideas, examples, dos and don'ts, and design recommendations to help these professionals understand the opportunity to integrate aquatic habitat into their designs.

River access is not just to launch your kayak or play fetch with your dog. River access is for people from the neighborhoods near the river. Where a young couple wheels their new baby outdoors for the first time, where a grandparent brings a grandchild to learn fishing, where kids skip rocks and watch beavers and stalking birds at work, where teachers bring the class to collect macroinvertebrates and release their

Trout-in-the-Classroom raised fish, where new anglers tryout their gear, learn to cast and feel a fish hit their lure for the first time, where injured anglers can hobble and cast as they recover, where workers can steal a few minutes to cast, catch, and release before or after work with their kids, and where senior anglers can practice their lifetime sport without the risks of the high country.

Providing access to the river must be paired with attention to habitat protection and restoration, sediment transport, flood control, fish passage, recreational fishing and overall ecosystem function. Previous projects on the Denver South Platte have proved that good design can result in both flood control, a healthy river and a successful fishery.

Angling is growing in popularity across the country and there are very few places where people can walk or ride their bikes to a world class fishery. The Denver South Platte can be one of these places! The river supports healthy fish populations, but they are under increased pressure from climate change and access to the river is not distributed equally throughout the city. In the next decade, millions of dollars will be invested in the Denver South Platte. It is critical that these projects support healthy river function as well as to provide equitable access for people of all ages, backgrounds and skill levels to connect with their home river.



Background

Denver Trout Unlimited is a local non-profit with over 1,500 members focused on improving the health and habitat below the waterline of the Denver South Platte. Denver Trout Unlimited conducts a variety of programs including monitoring and educational programming for Denver youth. We are critical stakeholders with extensive knowledge of the river and regularly contribute to the design and construction of projects.

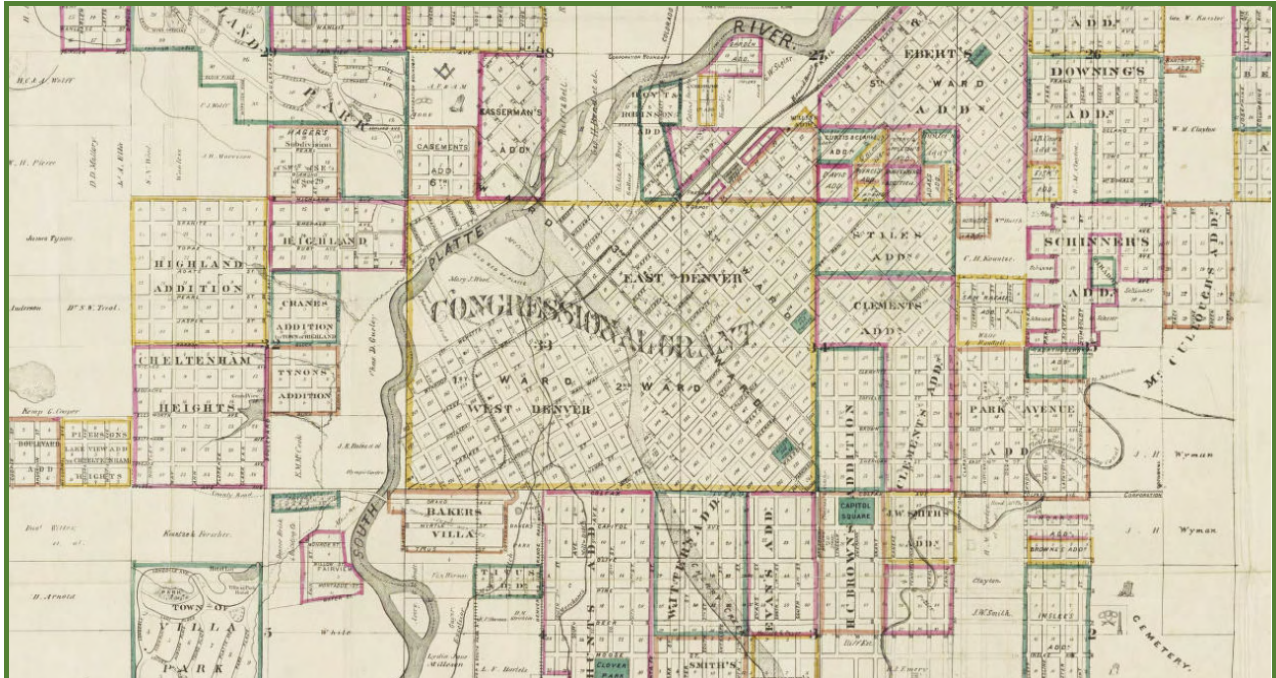
Through our work it is apparent that many kids have never gotten their feet wet in their home river. They are unsteady walking down the bank and over rocks. They are astounded by the diversity of life under the rocks near shore. They are terrified by the thought of leeches in the water. But after a few hours they love their river and understand why it is sometimes off color as it carries sediment from the Rockies to the plains. They understand how easy it is to keep trash out of their river and how much fun it is to connect with and release a wild species on the other end of a fishing line. And they understand their river is healthy and getting better with the major river projects on the drawing board.

Our Home River

Rivers are an accumulation of inputs. Streams and rivers are formed as water from the surrounding landscape flows downhill, growing in size and accumulating sediment, pollutants and nutrients along the way. Here in Denver, the South Platte is our river.

In its historic condition the Denver South Platte was a meandering river filled with complexity and life. Without dams or concrete banks, the river's water levels would rise and fall throughout the year – swelling with spring snowmelt and transporting large amounts of sediment from the mountains. It would overflow its banks to form new channels and move across the landscape creating wetlands and complex floodplain habitat. Over 75% of species in the West need healthy floodplain, or riparian, areas to complete their life cycle (Montgomery, 1996). Like all wild rivers, the South Platte was a dynamic system – everchanging and persistent.

The City of Denver literally grew up around the river. Cheyenne and Arapaho Tribes occupied this area and had seasonal camps near the confluence of Cherry Creek and the South Platte. When prospectors discovered gold on the site in 1858 a flood of people began to descend on the quiet river valley. The South Platte was immediately altered to facilitate the extraction of raw materials – channels were straightened, wetlands filled, and flooding controlled. As industry grew, businesses literally turned their backs on the river and oriented their storefronts towards the new gridded streets while dumping their waste in the river at the back of the shop. From the late 19th through the mid-20th century the river was viewed largely as a dumping ground and ecologically dead.



Thayer's Map of Denver in 1879 depicts a changing South Platte. Islands, gravel bars and a wide river corridor is still present providing a glimpse of the historic character, but urban development is beginning to lock the river into place. Restoration does not aim to bring back the historic condition but by understanding it we can develop better designs that work with the natural processes of the river. – Credit, Denver Public Library

However, on June 16, 1965, the river came roaring back to life. Intense rainfall in the foothills caused the largest flood and most costly natural disaster in Denver's history. **“Instead of the normal 300 cubic feet of water per second, or the 3,000 that we called exceptionally high..., the raging South Platte hit us with the astonishing flow of 150,000 cubic feet per second”** (Returning the Platte to the People, Joe Shoemaker, 1981). More than 250,000 acres of land were inundated by the flood, resulting in \$540 Million in damages or approximately \$14 Billion in today's dollars. While the 1965 flood was devastating it also made people consider the river they had forgotten and prompted action.

In 1974, Mayor Bill McNichols and State Senator Joe Shoemaker co-founded the Platte River Development Committee (PRDC) and set out to revitalize the Denver South Platte. They embarked on an ambitious program to ensure such a disaster never occurred again and transform the river into a vibrant amenity for the city.

Over the last 50 years more than \$500 million has been invested in the Denver South Platte to improve water quality, recreation, flood control and restore the environment. Over 100 acres of parks and natural areas and over 100 miles of multi-use recreation trails have been constructed along the river and its tributaries (Shoemaker, 1965). A recent economic study found that

improvements to the river have resulted in over \$10 billion in new development with much more on the horizon.

How to use the document

This document is organized into four sections – Life Under the Water, Current Management General Guidelines, Technical Considerations, Examples of Good Habitat from the river and Lessons Learned for designing universal river access points along the Denver South Platte.

The term “universal access” is defined as “the design and composition of an environment so that it can be accessed, understood, and used to the greatest extent possible by all people regardless of their age, size, ability or disability” (The Centre for Excellence in Universal Design). This definition goes beyond ADA Accessibility and more clearly aligns with Denver Trout Unlimited’s vision to create high quality fishing access to the Denver South Platte for all people.

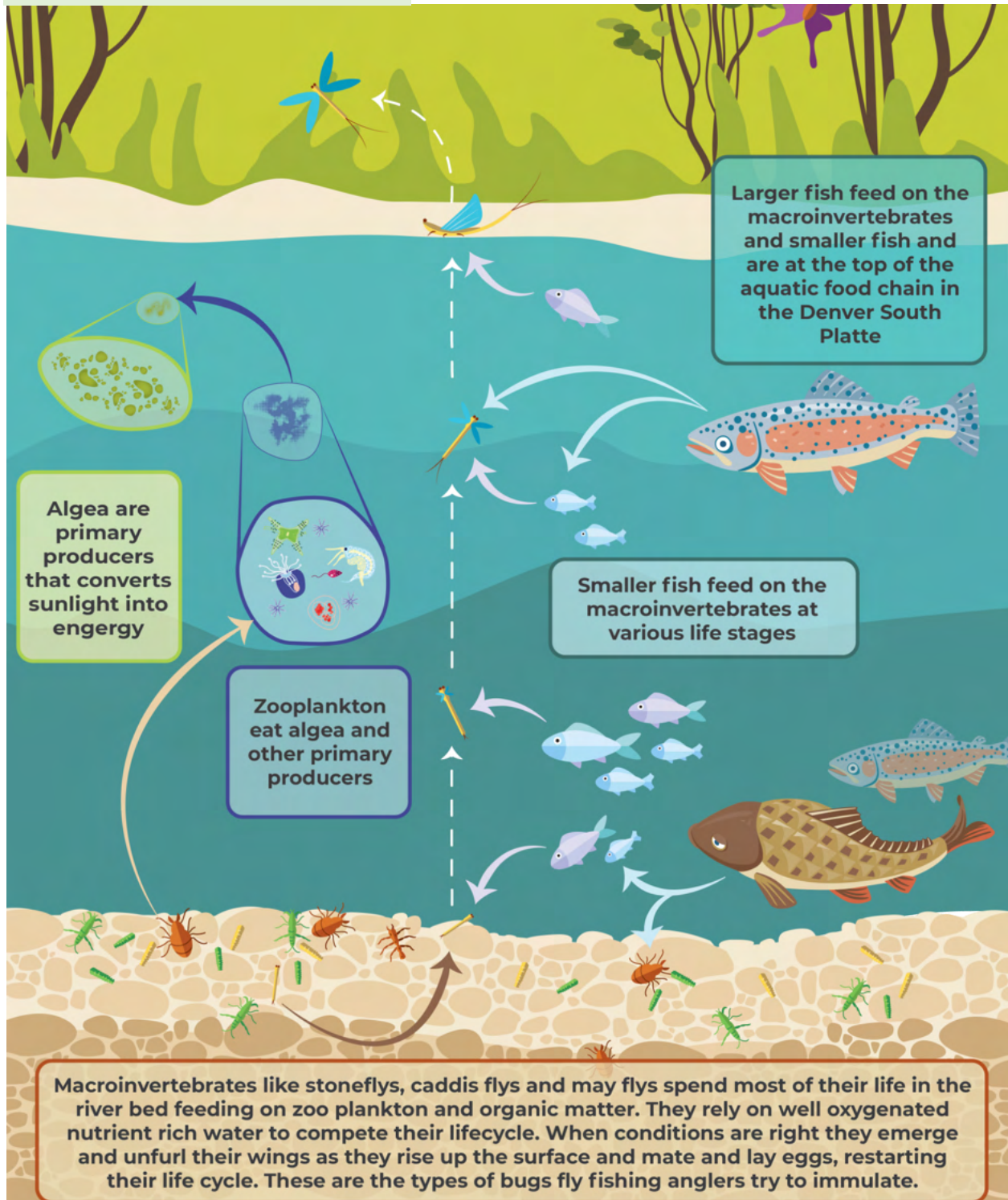
The structure of this document will provide designers, engineers and contractors a solid foundation of the history and environmental conditions that have shaped the river and must be understood in order to put it back together.

Conceptual diagrams and recommendations shall not be used for construction of any kind. They are intended to provide an example of potential design options only. All final designs should be developed with the assistance of a licensed professional and approved by the Mile High Flood District and/or the City and County of Denver prior to construction.

Life Under the Water

A healthy fishery starts with a healthy river. Clean, oxygenated water, high in nutrients provides the building blocks for a complex food web under the surface.

Denver South Platte Food Chain



There are a variety of different native and introduced fish species that call the Denver South Platte home. According to Colorado Parks and Wildlife (CPW) and the United State Geologic Survey (USGS), the following species have been documented.

- Walleye
- Smallmouth Bass
- Rainbow Trout
- Brown Trout
- Longnose Dace
- Longnose Sucker
- Largemouth Bass
- Yellow Perch
- Channel Catfish
- Common Carp
- Flathead Minnow
- Creek Chub

All species play a unique role within the ecosystem and have shared needs, including:

- Connected habitat free of barriers to movement and migration
- Clean, cool, oxygenated water
- Areas of refuge such as overhead cover from predators
- Complex habitat that includes high velocity sediment transport structures and low flow channels, deep pools, runs, tail outs, riffles, gravel beds, sand bars, cuts, inside and outside bends, and shelves for various life stages of fish and macroinvertebrates, seasons, and river flows.
- Abundant food supply delivered to safe feeding areas.

The Trout, Walleye, Bass and Carp are attractive to DSP recreational anglers. These species can share the same habitat and do exist throughout the Denver South Platte. Denver South Platte is a transition between cold water high mountain streams and warm water plains rivers. Denver Trout Unlimited members and environmental DNA analysis¹ have found both cold and warm water species in the Denver South Platte.

Denver Trout Unlimited has been recording hourly temperatures at eight sites chosen with the help of Colorado Parks and Wildlife biologists since 2016. This data shows that our temperatures from Chatfield through downtown are not that much different from other rivers at our elevation in the state. Macroinvertebrate sampling in the same locations prove that there is plentiful food to support a diverse and healthy fishery.

Water quality and fish passage are perhaps the most important elements of creating a healthy habitat. It doesn't matter how much physical habitat is available, if the water chemistry is toxic to fish or they can't access food or safe shelter they will not survive.

Millions of dollars continue to be invested to assure clean water flows into the river from populated areas. Blockage structures are being removed or redesigned to improve fish passage. Both will enhance possibilities for angling access areas in previously unhealthy stretches of the river.

¹ Environmental DNA or eDNA analysis is a process where the DNA of a water sample is sequenced to identify the species or pathogens present in the sample. This inexpensive and reliable approach can greatly advance our understanding of our home water and help manage a diverse and healthy fishery.

Current Management

Today, the South Platte through the City of Denver is primarily managed by Mile High Flood District (MHFD) and the City and County of Denver. The State and the U.S. Army Corps of Engineers also manage multiple dams upstream of the city that regulate flows to reduce the potential for major flood damage and individual projects are continuously developed to address localized flooding, restore habitat, and improve recreation. The primary factors in current river management are:

- Flood Control and Water Supply
- Sediment Transport
- Maintenance
- Recreation

MHFD's top priority is to ensure public safety. They accomplish this by managing creeks and the Denver South Platte such that those systems convey floodwater away from people and property. MHFD also works with the City to deter encroachment from new development into the floodplain.

During spring runoff and following thunderstorms, the South Platte transports a large amount of sediment. It is important to keep that sediment moving downstream of the city, so it does not build up and change the flow of the river, elevation of the riverbed and flood height.

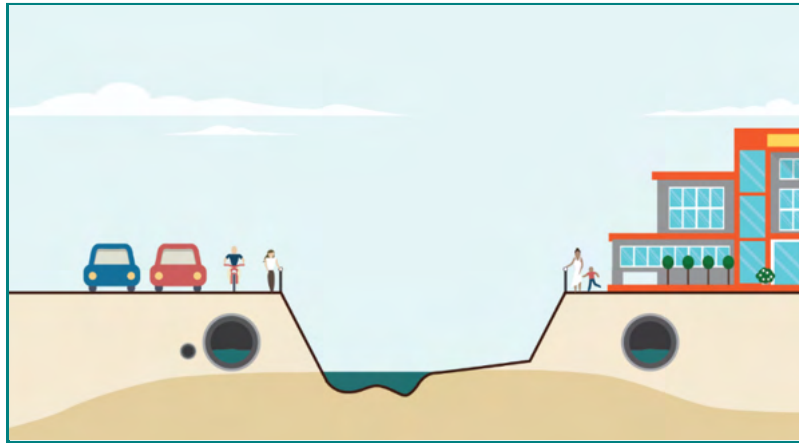
Wherever possible, the MHFD seeks to maintain a multi-stage cross section which includes a low flow channel to transport sediment as well as floodplain benches that allow floodwaters to spill over their banks at specific intervals – providing water, sediment and nutrient inputs to riparian areas. Urban development, however, has constrained the river channel in many places and infrastructure such as roads, buildings and utility lines often border the river corridor. As a result, creating a multi-stage cross section, which often reflects a healthy river, is not possible in all places. Nonetheless, strategic habitat restoration CAN occur even in the most constrained environments. See example cross sections below.

MHFD staff continuously monitor the conditions along the river and conduct routine maintenance to remove unwanted sediment, obstructions, and garbage, which can impact flood flows. Slow moving stagnant water where sediment and garbage can collect

A variety of sediment types are transported in rivers. The velocity of the water and size of the sediment determines when and where they will be deposited. The fast-moving water of mountain streams can carry larger sediment - that's why they are typically made up of boulders and larger cobble. As the slope of the river becomes more gradual the water slows down and no longer has enough energy to transport larger sediment, so they deposit on the riverbed. Lower gradient streams like the Denver South Platte typically transport smaller sediment material like small cobble, gravels, and sands, which deposit in slow moving areas within the river creating new gravel bars, riffles, and beaches.

are discouraged as are large clumps of willows along the bank that regularly capture garbage and debris.

The City and County of Denver regularly partners with the MHFD to integrate recreation and river access into projects. This comprehensive approach provides multiple benefits to residents and is one of the main reasons the Denver South Platte has become such a valued community amenity. The following cross sections illustrate how the river has been modified in different parts of the city and the habitat opportunities available.



Constrained Section

Many sections of the DSP are bordered by roads and infrastructure. In these constrained sections, efforts should be focused on establishing a low flow channel and instream habitat improvements associated with more architectural river access designs.



Moderately Constrained Section

In some locations it may be possible to layback one bank but not the other. Every effort should be made to remove fill, establish a low flow channel, increase habitat, restore riparian buffers, and create gradual angling access.



Naturalistic Section

A multi-stage cross section includes a low flow channel and floodplain/riparian benches. Opportunities to restore the full cross section on the DSP are limited but are encouraged wherever possible to provide diverse angling access in conjunction with restoration.

General Guidelines

Angling access points are the gateways to connecting people with the river and must be designed to support healthy river function. Successful angling access starts with the right team. The following experts are recommended for projects on the Denver South Platte include:

- Civil Engineer
- Hydraulic Engineer
- Aquatic Biologist
- Landscape Architect/Urban Planner
- Geomorphologist
- Ecologist
- Contractor with river restoration expertise
- Experienced Angler (20yrs) or Licensed Fishing Guide for the river.

This team will ensure that the river access is designed to work with the dynamic nature of the river environment, is located near healthy fish habitat and habitat features are included and that the project is constructible and cost effective.

According to the National Park Service, the following core elements should also be considered when designing river access points. These elements are important to all stakeholders and should be communicated and considered throughout each step of the planning and design process.

System and Location

The location, geomorphology, and physical characteristics of a site.

Landscape Setting

The site-specific features and conditions that define a setting – including natural and manmade.

Temporal Dependence

The seasonal nature and timing of on-site activities and how variability of water levels may affect visitation and user behavior.

Frequency

When and how often activities occur at a site and how that site activity integrates or impacts the biological setting and natural resources.

Density

The number of individuals who will use a site and the site's spatial constraints that define how well desired uses can be accommodated.

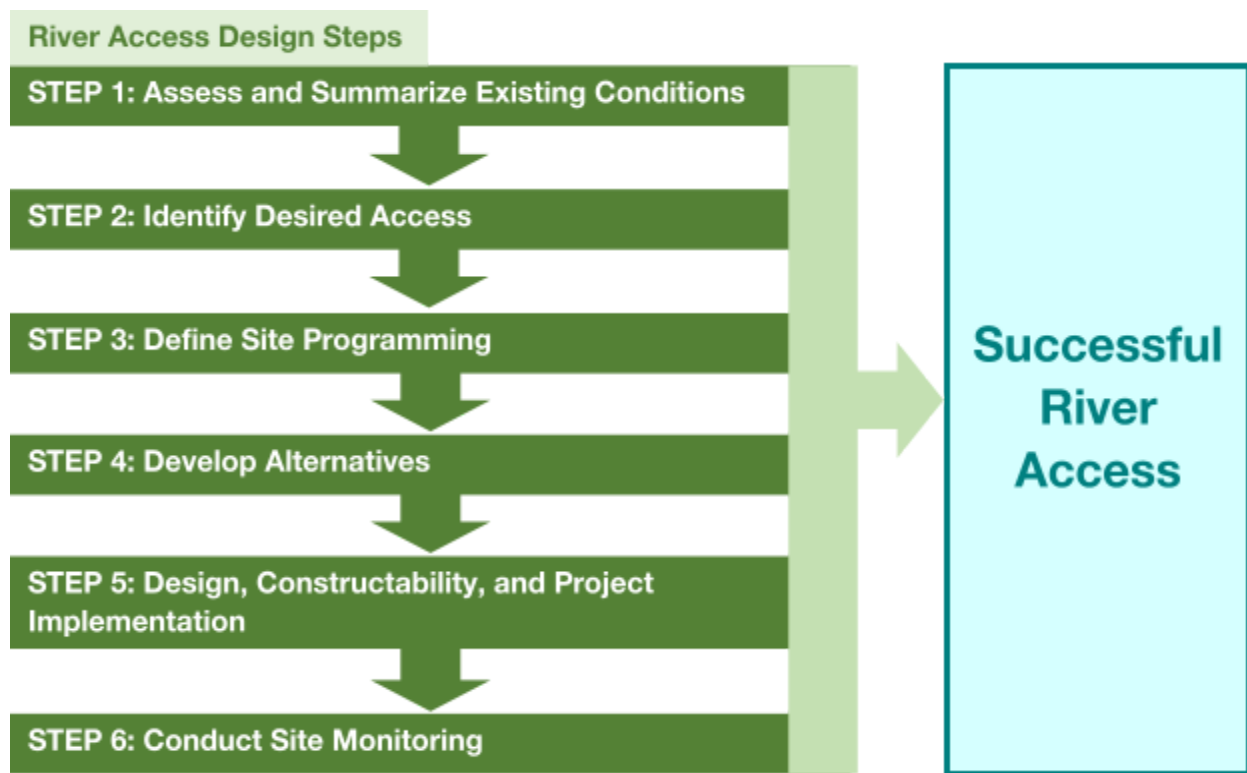
Use Type and Challenge Level

The activity types and challenge levels occurring at the site.

Management

The needs and challenges site owners face and the resources available for operations and maintenance.

Applying the core elements should occur through a step-by-step process that can adapt to a variety of river conditions.



STEP 1: Assess and Summarize Existing Conditions

The first step to well-designed angling access is to establish baseline knowledge of the Denver South Platte. This is done by assessing the habitat opportunities in different areas, documenting the existing access points and transportation routes, understanding regulatory and management frameworks, and identifying good fishing areas within a specific project area. If you are unclear about the good fishing areas or habitat opportunities, please contact Denver Trout Unlimited.

It is also critical to understand the surrounding community values through a robust public engagement process before developing an access point. Please reference Denver's [Neighborhood Planning Initiative](#) and the [City of Denver's Public Engagement and Communications Recommendation](#) at the beginning of your design process.

STEP 2: Identify Desired Access

During the public outreach process, identify a shared vision for the project area based on existing conditions, regulatory and management framework, stakeholder concerns or interests, and the existing and potential recreation uses conducive to healthy habitat. This process involves listening to stakeholder concerns, sharing ideas, and incorporating the perspectives of a diverse planning team.

Engage local non-profits like Denver Trout Unlimited, the Greenway Foundation, Lincoln Hills Cares, and Hispanics Enjoying Camping, Hunting and the Outdoors (HECHO) early and often in the public outreach process. Local non-profits have unique knowledge of the river system, typically have long standing trusted relationships with the local communities and often have plans or ideas about a specific area.

Denver Trout Unlimited is focusing their educational efforts in connecting Denver South Platte neighborhood kids with their home river through Trout-in-the-Classroom (3rd to 12th grades) sponsorship, telemetry, livestream video, STEAM program (Science, Technology, Engineering, Art, and Math- High School, Tech and Community College) resources, Environmental Career Pathway volunteers (18 to 30 yr olds) real world environmental DNA projects, and water focused Internships (high school and college). Denver Trout Unlimited provides resources for Lincoln Hills Cares, HECHO, Denver Public Schools, Littleton Public Schools, and SD 27J.

The Greenway Foundation is a local non-profit that advances sustainable watershed planning, promotes water stewardship and has a variety of educational and recreational programs along the river. They host the South Platte River Environmental Education (SPREE) program which conducts field trips, summer camps, and after school programs along the river.

HECHO is engaged in building strong, culturally-rich Hispanic communities connected to nature and each other.

Authentic engagement with these groups early will allow you to leverage their knowledge into more functional designs and potentially better position you for grant applications.

STEP 3: Define Site Programming

The site program is derived from the public engagement process. A successful river access point will be located near healthy fish habitat to support angling but should also allow for education, group gatherings, dog walking, individual reflection, and other aquatic recreation.

All access points should provide universal access to all visitors regardless of their age, size, ability, or disability. Additional details on designing universal access points can be found in the Technical Considerations in the next section.

STEP 4: Develop Alternatives

Work with the community and stakeholders like Denver Trout Unlimited to develop a suite of conceptual alternatives for the river access point. Alternatives could include different sizes, layouts, materials, elevations and location to support the best fishing.

All access points should be designed so as not to cause a rise in the 100-year floodplain (1% annual chance of occurrence). For additional information on flood risk for your project please review the [City of Denver's floodplain maps, regulations and permit submittal requirements](#).

Trail configurations to the access point itself could vary based on the location of the access. Trails within the city could be made of crusher fines, concrete or a combination. Concrete is

preferred because it can resist erosion, is low maintenance and is durable under flood conditions. All trails must follow ADA guidelines per the [City of Denver's Design Standards](#).

Once alternatives have been developed, develop a preferred alternative to advance to construction documents.

STEP 5: Design, Constructability, and Project Implementation

Consult with the City of Denver and the Mile High Flood District throughout the design process. When designs reach a schematic level, begin reviewing with a local contractor.

Schematic design sets up the general idea for a project and design development focuses and refines it. Construction documents fill in all the details. The final set of drawings will specify every element of the project, from the channel alignment to the location of habitat features. Construction documents serve two purposes: to apply for (and receive) permits from the City and County of Denver or other local authority, such as MHFD, and to construct the project.

MHFD follows an alternative project delivery option, called Project Partners. The Project Partners process engages owners, consultants, and contractors at the onset of a project to work collaboratively to deliver goal-based projects. This delivery process incorporates a systems thinking approach of looking at the bigger picture to develop better long term holistic solutions. More specifically Project Partners uses project goals to lead the design and construction process as well as build collaboration between partners. For more information, please review the [MHFD's Project Partners process](#).

STEP 6: Conduct Site Monitoring

Following construction, monitoring is important to identify what is and is not working once a site has matured. Monitoring data can provide critical insights into how the site changes over time, which will inform maintenance activities or adaptive management approaches and improve future designs. The City of Denver and the MHFD monitoring the river corridor for maintenance concerns and can help identify issues at specific sites overtime. Denver Trout Unlimited will monitor the habitat response through fish surveys, ongoing water quality monitoring and Environmental DNA monitoring for macro-invertebrates and fish species.

Technical Considerations

The Denver South Platte is a unique ecosystem with its own unique management challenges. The following section outlines the most important technical elements to consider when designing access points in this system.

- **Access points must be located near healthy fish habitat and include restoration where applicable.** Examples of healthy fish habitat on the Denver South Platte are included in the following section.
- **Access points should be located within ¼ to ½ mile from a parking area or road.**
- **Trail must be less than 5% slope and made of concrete or crusher fines to meet ADA criteria and allow wheelchair access.**
- **Access points should be placed in depositional areas (like an inside bend) but border faster moving water for casting.**
- **Access point design should address the entire channel cross section and establish a low flow channel to transport sediment.**
- **Access points should tie into bedrock below the river and allow for access at different water levels.**
- **Access points should be located within 10-50' from habitat features like a pool or boulders so that an angler can catch a fish while on the access point itself. Habitat features should be incorporated into the design of the access point.**
- **All access points must be designed to withstand the forces associated with a 10% annual chance flood event at a minimum. Access points in the Denver South Platte must follow MHPD design criteria, specifically Chapter 9: Hydraulic Structures and Chapter 10: Stream Access and Recreational Channels.**
- **Willows and dense vegetation are not recommended near the access points because they accumulate garbage and can decrease sightlines, causing safety concerns.**

The Denver South Platte is unique in many ways – including habitat.

Ronny Crawford is an expert at reading this river and knowing just where the fish are holding. A 30-year resident of the Overland neighborhood, Ronny is an institution.

I once went fishing with Ronny near Grant Frontier. Despite some recent improvements to the park, he took me just upstream where the river retained some of its industrial character. Instead of fishing around newly placed boulders, he told me to cast upstream and try to drift between an old shopping cart and car tire.

He knew something – probably a lot – that I did not. Fish don't really care how pretty something looks they just care how it functions. Ronny knew that that shopping cart and tire provided overhead cover and slow water where the fish felt comfortable and there would be a big trout in there – if I only knew how to catch it.

- **Trees such as Cottonwoods and Peach Leaf Willows are encouraged in the riparian areas along the Denver South Platte to shade the water and reduce water temperatures. They also aquatic species food from the terrestrial environment - like insects and plant material for macroinvertebrates to eat.**
- **Access points must be designed to support educational programs.**
- **All habitat elements and access points should aim to be low maintenance. Please contact MHFD and City of Denver to learn more about maintenance activities and best practices.**
- **Full spectrum of flows needed to understand river processes and aquatic habitat design**
- **Consider if any sediment is transported at lower flow and the likely response of aquatic habitat features to sediment transport dynamics.**

The flows in the Denver South Platte are variable, rising spring pulses from snow melt in the Rocky Mountains and lowering to almost dry conditions during other times of the year. Prior to the flood control era (1940 to 1980), it carried little water during the summer other than following severe rainfall events and dried up completely in some years. Dams and their reservoirs, however, essentially reversed this pattern, lowering the base flows during spring, while increasing the summer flows, converting the river from intermittent to perennial. In addition to the dams, urbanization of the floodplain and conversion of prairie vegetation to residential and commercial developments also altered runoff patterns. Therefore, anticipating widely fluctuating stream flows is an important part of evaluating potential aquatic habitat elements for any project. Any design team should conduct a statistical hydrologic analysis related to common flows to determine the likely number of days at particular flow levels. Designers should use these data to determine the appropriate types and locations of in-stream habitat. Designers all need to consider geomorphology and sediment transport. The river transports sediment at lower flows because it is a sand system, which also influences aquatic habitat types and locations.

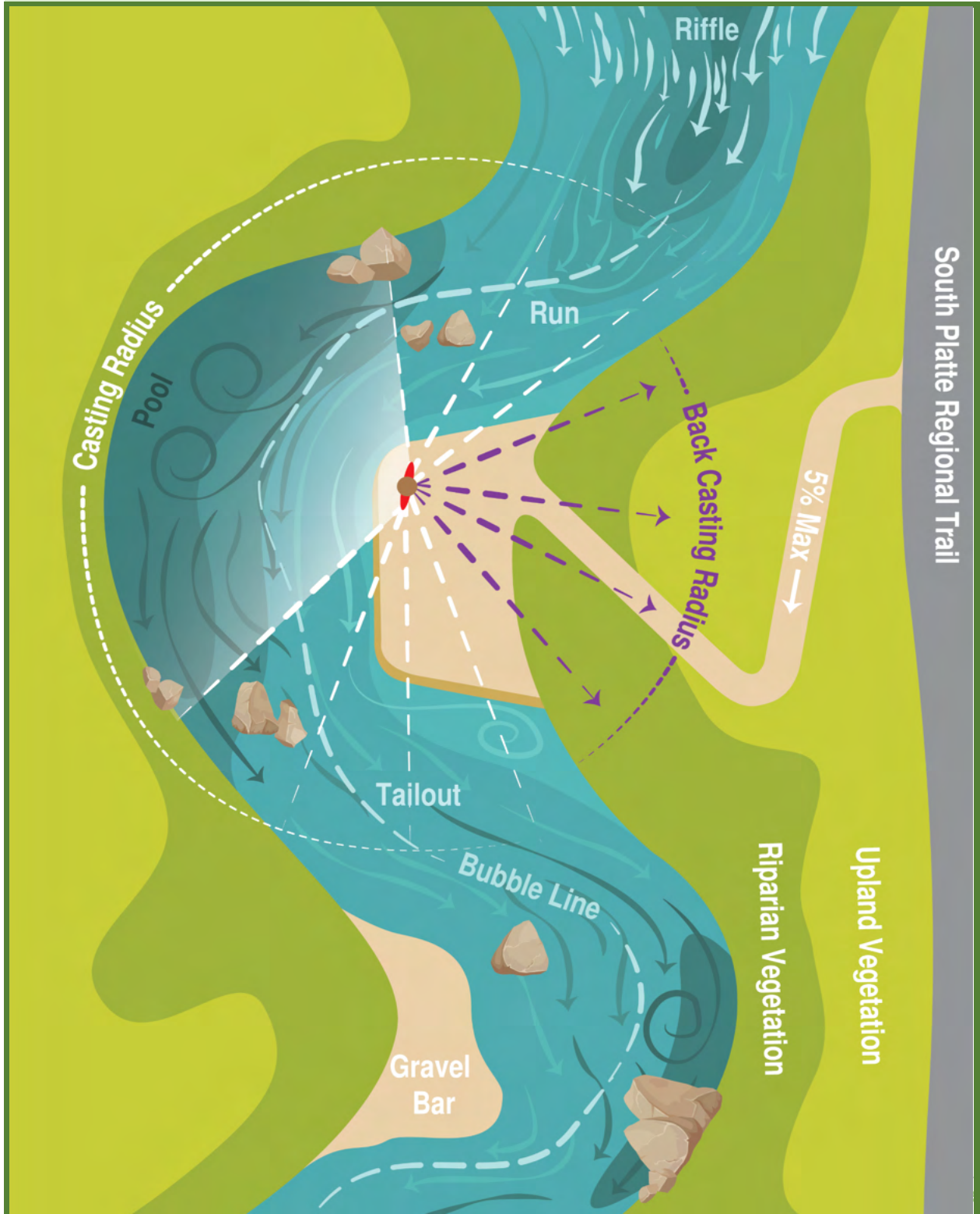
For more technical information on river restoration design please reference the following resources.

- [California Department of Fish and Game California Salmonid Stream Habitat Restoration Manual](#)
- [US Bureau of Reclamation Rock Ramp Design Guidelines](#)
- [Washington State Department of Fish and Wildlife Stream Habitat Restoration Guidelines \(Chapter 5\)](#)
- [Fish Barriers and Small Plains Fishes: Fishway Design Recommendations](#)

The most successful access point to date was added during the Overland restoration. Based on guidance from Ronnie Crawford of Denver Trout Unlimited, the initially designed flow was modified from the left downstream channel under the Florida Avenue bridge to the right channel and a large boulder structure placed on bedrock was located under the bridge in this new channel. This low (or no cost) change preserved and enhanced “Ronnie’s Hole” a favorite

bass hangout just downstream of the bridge and within casting distance of the designed ADA access area. The geomorphology was excellent and the hole has persisted since 2015 without maintenance during a wide range of floods and flows. (See the Lessons Learned section for more information.)

Angling Access Diagram



Examples from the River

This section provides examples of the types of healthy habitat needed to support healthy fish populations and good angling in the Denver South Platte. Designers should consult with an aquatic biologist and geomorphologist prior to beginning work to identify where these features exist within their project area. **Access points should be located within casting distance of existing healthy fish habitat and new habitat features such as boulders, overhanging banks and deep pools should be incorporated into the design.**

Low Flow Channel



Restoration upstream of Florida Avenue established a low channel through the creation of riffles, pools and other instream structures. This low flow channel transports sediment, scours pools, oxygenates the water, and acts as the primary current for carrying macroinvertebrates (fish food) through the river. Anglers can often distinguish the low flow channel by the line of bubbles carried by it, giving rise to the term Bubble Line. Watching where the bubble line goes often provides anglers with a good idea of where the food is flowing and thus where the fish are likely holding.

Fish Passage



Dams and grade control structures are channel spanning features placed in the river to control the slope of the river bed, reduce erosion, enable water supply and maintain a semi-stable channel. Many of the historic grade control structures on the Denver South Platte did not consider fish passage in their design and block many aquatic species' ability to move up and downstream to access food, habitat and spawning areas. Large grade control structures can be removed and replaced by multiple smaller structures that mimic natural features while maintaining their intended purpose and increasing fish passage.

Deep Pools



Deep pools hold cold water even in the summer and are important refuges for fish. Oftentimes large fish will hold in deep pools where they feel protected and have easy access to abundant food floating downstream. Photo Credit: Barb MacAndrew at Aspiring Fly Fishing (MacAndrew)

Runs



A run is deeper water with smooth, uniform currents immediately downstream of a riffle. Fish hold in this current feeding on macroinvertebrates that are transported through the riffle. The Children’s Museum Run is just downstream from the existing Mile High riffle and was carved by flood flows against the rock bank supporting the South Platte River trail west. Access is from South Platte River trail east.

Tailouts



Tailouts are the downstream end of a run or pool where the water depth shallows and the speed of flow picks up before dropping into the next stretch (Monahan). Fish hold behind even the smallest structures in tailouts so we recommend adding instream habitat features, such as boulders, LUNKER structures, or anchored root wads to provide cover.

Riffles



Shallow fast moving water over a cobble base causes what anglers call a riffle. Here at the Mile High Riffle we can see kids from the Lincoln Hills Cares Career Pathways program fishing the riffle, bubble lines, and the pool created at the end of the riffle where the fast moving channel flattens out as the river widens.

Inside and Outside Bends



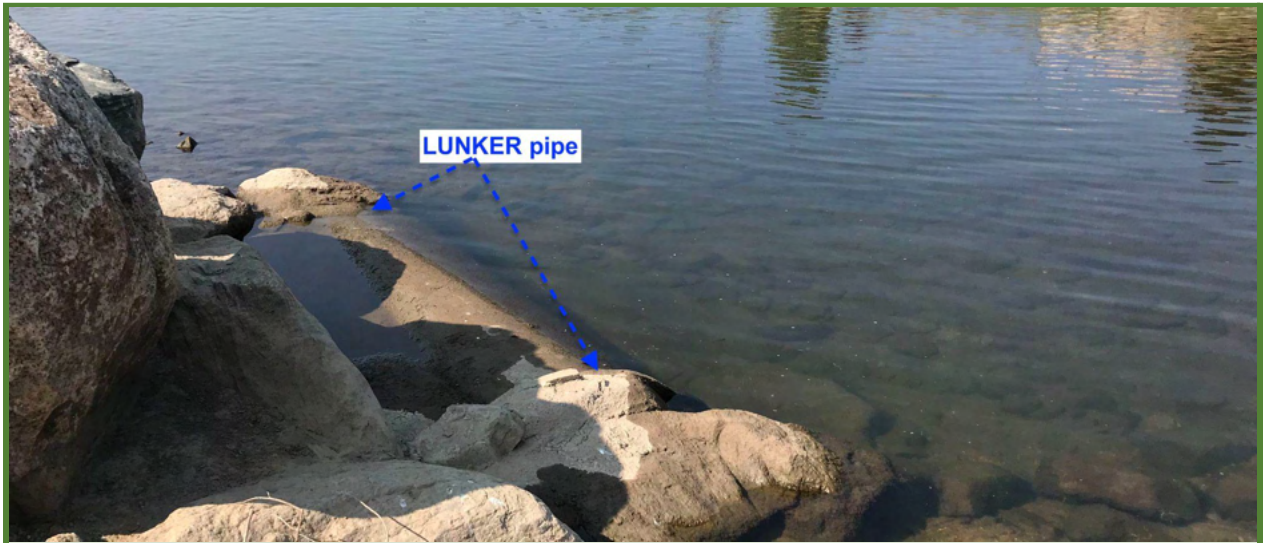
Water moves faster along the outside of a river bend eroding the banks and often carving out deep pools or runs. This results in steeper banks with more limited access but also creates good fishing opportunities. Water moves slower on the inside bend depositing sediment and creating gravel beds. Inside bends are often good locations for access points.

Gravel Beds

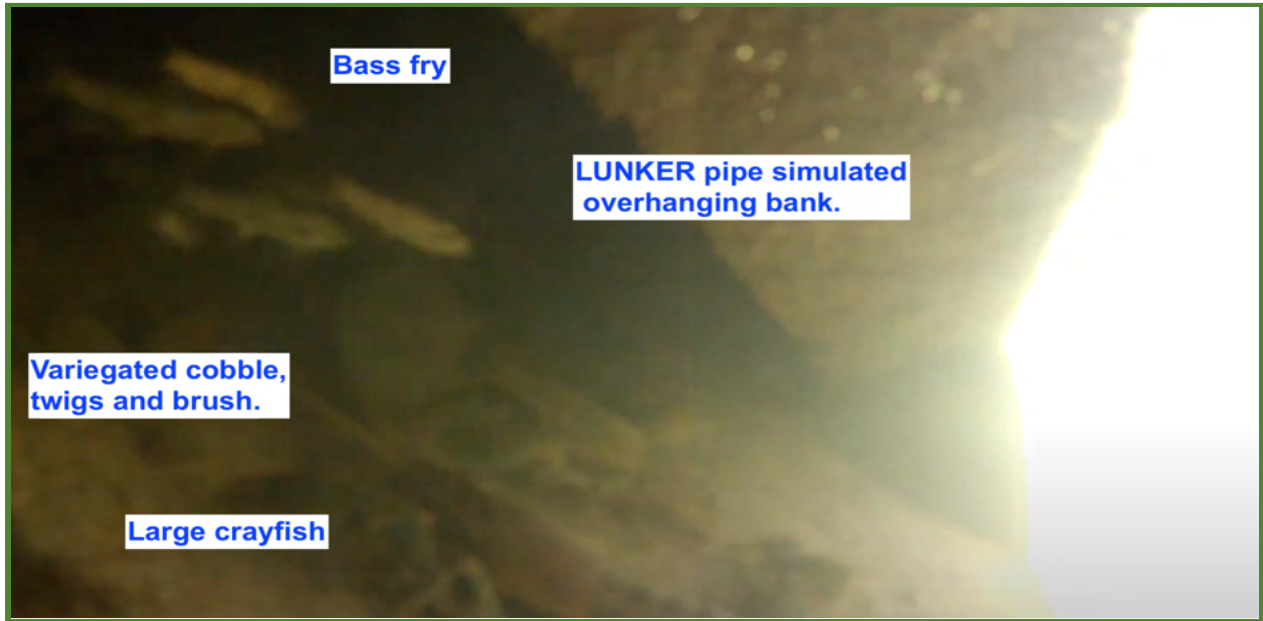


Gravel beds occur in depositional areas with slower moving water on the inside bends of rivers or at confluences of the Denver South Platte and tributaries. Gravel beds provide gradual access to the waterline and easy casting to the opposite bank where velocities are greater and more fish may be holding in deep pools.

Overhanging Banks



Overhanging banks provide good overhead cover for young and mature fish, crayfish and macroinvertebrates. The overhanging bank allows fish to easily move in and out of the current - eating food as it goes by then returning to safety. Denver Trout Unlimited designed and tested LUNKER (Large Underwater Non-Kinetic Embankment Replacements) at RiverRun park on the Denver South Platte. The bass fry and crayfish loved their new home. The variegated cobble placed during installation and twigs and branched washed in provide shelter for young fish from predators.



Shelves



Underwater shelves a foot or two below the water line are created when gravel is moved through a riffle and deposited to form an underwater bar anglers call a shelf. Fish love to hang out on shelves where they can rest in slow flowing waters and then dart into the edge of the current to feast on macroinvertebrates being delivered by the fast water of the riffle.

Lessons Learned - Easy Fixes for the Future

Millions of dollars have been invested in the Denver South Platte to improve habitat and river function and millions more are on the way. This section highlights past projects that should be used as examples for future work as well as identifies opportunities for improvement.

Natural Restoration Success at Carson Nature Center



The 2013 joint South Suburban Parks, Mile High Flood Control, and Denver Trout Unlimited project proved the concept of a Denver South Platte river restoration which includes good access, underwater habitat and adherence to flood control requirements can indeed create a fine recreational fishery.

Denver Trout Unlimited LUNKERS at River Run Park



“LUNKERS” are artificial structures that provide cover for fish along the streambank. River Run Park was primarily designed for kayaking and surfing with limited consideration of habitat during the initial design phase. Denver Trout Unlimited designed and worked with the contractor to install LUNKERS during the project to provide fish habitat. Since their installation underwater videos have shown fish, crayfish and macroinvertebrates of all ages thriving in the structures. Future projects should incorporate habitat elements like LUNKERS from the beginning so they can be more integrated into the overall design and programming of the site.

River Access Upstream of Florida Ave - some boulder clusters and low flow channels



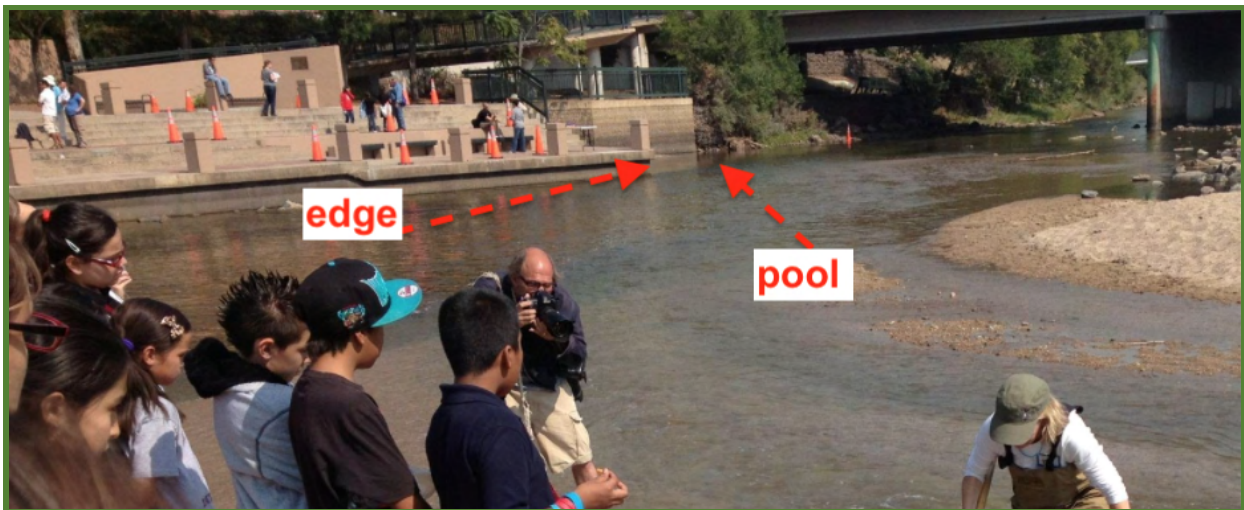
The river access point between Florida Ave and Pasquinell’s Landing Park was installed on an inside bend and depositional area. It was constructed with a gradual slope that ties into the riverbed and provides ADA access to the waterline at all times of year. Additional instream habitat features could have been installed with this access to increase angling opportunities.

River Access South of Florida Ave - some overhanging bank



The access point north of Florida Ave. was located near a prominent fishing hole. However, it was constructed a little too high and slopes abruptly to the riverbed - not providing ADA access to the main channel. An aquatic biologist suggests minor changes in the concrete pour configuration to create 6 to 12 inch overhanging banks would provide shelter for fish. A lower elevation and more sloping grade coupled with additional instream habitat features could have increased the angling potential.

Confluence Park



The original shape of Shoemaker Plaza produced an eddy at the downstream end which carved out a nice hole where fish regularly congregated. The new design does not create the same currents and the hole has since filled in with sediment, reducing the overall fish habitat of the site. Additionally, if the tops of the walls were designed to overhang the river slightly they could have functioned much like a LUNKER - mimicking an overhanging bank and increasing fish habitat overall.

Pasquinel's Landing Park



Two low water crossings to an artificial island provide access to the waterline at Pasquinel's Landing Park. These crossings have the unintended consequence of trapping garbage. This has created an unsightly feature for park visitors and a maintenance challenge for Denver staff. Future designs should limit crossings and prioritize natural river features.

Grant Frontier Park



Instream boulders were not included in the design but added later during construction but without the help of an aquatic biologist or geomorphologist. As a result they do not create downstream areas fishable from this otherwise great access area. Without upstream structure to create a high speed sediment transporting run along the far bank, sediment is gradually filling in all the river bottom around the boulders toward the near shore

Carson Nature Center



Instream boulders were placed on soft bed sediment substrate and quickly sank out of sight to bedrock.

Lair O' the Bear Park - Jefferson County



This fine deck set 3 feet above Bear Creek can function as an observation deck but any angler using the deck will spook all the fish within casting distance. Review by experienced anglers or licensed guides would have suggested that for angling, the access area should be at stream level and provide cover for the angler.

Old Colfax - MileHigh - Lakewood Gulch - Fish Passaged needed to escape events.



Runoff with NO ESCAPE. A localized cloudburst poured a massive amount of low dissolved oxygen water on the MiHi stadium lots and surfaces draining to Lakewood gulch in late August 2020. Two dams (RTD & Xcel) blocked fish passage to escape. Many large trout had nowhere to go and died of oxygen deprivation. Easily added fish passage channels on these two dams will provide an escape in the future.

Johnson Habitat Park - Fish Passage allows escape to shelter, cooler temperatures, food, and spawning areas.



Twenty four lanes of I-25 & local traffic drain into the Denver South Platte opposite Johnson Habitat Park. Cloudbursts and thaws wash tire micro-contaminants, additives, oil, de-icing materials and other pollutants instantly into the river. Because there are no dams or drops creating fish blockages, fish can easily escape and find sustainable habitat.

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Appendix A: Universal Access

Universal Design is the design and composition of an environment so that it can be accessed, understood, and used to the greatest extent possible by all people regardless of their age, size, ability or disability. According to the Center for Universal Design in North Carolina State University, the following seven principles "may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments."

We recommend reviewing these principles throughout the design process to ensure river access points along the Denver South Platte are accessible to all.

Seven Principles of Universal Design

Principle 1: Equitable Use	<ul style="list-style-type: none">1a. Provide the same means of use for all users: identical whenever possible; equivalent when not.1b. Avoid segregating or stigmatizing any users.1c. Provisions for privacy, security, and safety should be equally available to all users.1d. Make the design appealing to all users.
Principle 2: Flexibility in Use	<ul style="list-style-type: none">2a. Provide choice in methods of use.2b. Accommodate right- or left-handed access and use.2c. Facilitate the user's accuracy and precision.2d. Provide adaptability to the user's pace.
Principle 3: Simple and Intuitive Use	<ul style="list-style-type: none">3a. Eliminate unnecessary complexity.3b. Be consistent with user expectations and intuition.3c. Accommodate a wide range of literacy and language skills.3d. Arrange information consistent with its importance.3e. Provide effective prompting and feedback during and after task completion.
Principle 4: Perceptible Information	<ul style="list-style-type: none">4a. Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information.4b. Provide adequate contrast between essential information and its surroundings.4c. Maximize "legibility" of essential information.4d. Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).4e. Provide compatibility with a variety of techniques or devices used by people with sensory limitations.
Principle 5: Tolerance for Error	<ul style="list-style-type: none">5a. Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.5b. Provide warnings of hazards and errors.5c. Provide fail safe features.5d. Discourage unconscious action in tasks that require vigilance.
Principle 6: Low Physical Effort	<ul style="list-style-type: none">6a. Allow user to maintain a neutral body position.6b. Use reasonable operating forces.6c. Minimize repetitive actions.6d. Minimize sustained physical effort.
Principle 7: Size and Space for Approach and Use	<ul style="list-style-type: none">7a. Provide a clear line of sight to important elements for any seated or standing user.7b. Make reach to all components comfortable for any seated or standing user.7c. Accommodate variations in hand and grip size.7d. Provide adequate space for the use of assistive devices or personal assistance.

Appendix B: Planting Recommendations

Riparian vegetation is a key element of a healthy riparian ecosystem. Riparian trees and shrubs provide shade needed to cool down the Denver South Platte in the summer, organic matter, terrestrial habitat, and their roots hold the soil reducing erosion. Riparian trees and shrubs like Cottonwoods, Peachleaf Willows, Hawthorns, Alders, Dogwoods, American Plum and Chokecherry are good replacements for willows around access points.

Access points should be focused in areas with high quality existing habitat or habitat potential. Bank access is not encouraged throughout the entire river so a healthy riparian corridor can be maintained. For additional information on planting along the Denver South Platte, please review [Chapter 13: Revegetation of the MHFD design criteria.](#)

