Acknowledgments

Adams County Parks, Open Space & Cultural Arts

J. Byron Fanning, Jr. - Director
Marc Pedrucci - Deputy Director
Trevor Graff - Parks, Open Space and Trails Manager
Jason T. Baines, PLA - Manager of Planning, Design, and Construction

Stakeholders

E-470 Authority
Tim Stewart
Neil Thompson
Chuck Weiss

Bike Brighton

Thornton Parks & Open Space
Diane Van Fossen

Consultant Team

Stream Landscape Architecture
ERQ Resources
ContourLogic
Olsson
Table of Contents

Introduction

Purpose of the Master Plan 1
An Important Resource 2
Public Engagement 2
Natural Resources Inventory 3

Master Plan

Riverdale Bluffs Vision 4
Master Plan Overview 6
Site Perspectives 7
Detailed Master Plan 8
Typical Trail Sections & Narratives 10
Optional Trail Features 12
Trailhead Plan 13

Appendix

Project Process i
Natural Resources Inventory ii
Site Tour v
Drainage Report vi
Master Plan Cost Opinion xv
Introduction

The Riverdale Bluffs Open Space (the Bluffs) is a 226-acre, undeveloped parcel of rolling and sometimes steep prairie landscape overlooking the South Platte River Valley and the distant downtown Denver skyline. Located a half a mile west of the South Platte River, at Riverdale Road and 136th Avenue in Adams County, the Bluffs are an important addition to an already open space-rich area of the County. The site is adjacent to the County’s Regional Park, Riverdale Dunes Golf Course, a County owned, 81-acre, open space property and is located less than one mile away from the County’s Willow Bay Open Space and the South Platte River Greenway. The Bluffs location creates a fantastic opportunity to connect directly to these regionally significant recreational areas. The site is also located in a rapidly developing area, and adjacent to Riverdale Ridge High School and Rodger Quist Middle School, and could become a significant recreational amenity for the surrounding neighborhoods, as well as more regional County residents who are interested in taking advantage of this open space’s unique resources.

The Riverdale Bluffs property was purchased by Adams County using Open Space Sales Tax Grant Funds. This funding required a conservation easement to be placed on the property. The easement, held by Commerce City, restricts land uses that are inconsistent with the site’s open space values, including active or motorized recreation. The easement permits passive uses such as hiking, cycling, and wildlife viewing.

During the development of this master plan the County acquired the Baumgartner property, an adjacent 15.5-acre parcel southeast of the original Bluffs property that will become part of the Riverdale Bluffs experience. This former residence, situated at the top of a bluff, is anticipated be developed into a nature center by the County. Preliminary planning for this site was performed as part of this master plan to identify site access, parking, and potential open space trails that would complement the Bluffs facilities, however master planning for the former Baumgartner residence will occur at a later date.

Purpose of the Master Plan

The overarching objective of this master planning process has been to identify the best use of this open space resource for Adams County and its residents. To achieve this, the project team’s primary objectives included:

• Analysis of the open space’s natural resources and recreational potential;
• Evaluation of the regional context to identify opportunities for connectivity and improvements that would enhance and complement the larger Adams County open space system;
• Identification of a range of appropriate recreational activities for the site;
• Development of a range of appropriate land management guidelines to protect the open space resource;
• Engagement of the residents of Adams County into the planning process to provide guidance and feedback on the desired vision for the park;
• Refinement of proposed site improvements and land use recommendations into a coherent open space master plan that will guide the future development of the Riverdale Bluffs.

Figure 1: Map shows the regional context of Riverdale Bluffs property and proximity of Adams County recreation and open space network.

Figure 2: A bird’s-eye view of the Bluffs and the adjacent neighborhoods.

Figure 3: A view of the Bluffs central drainage looking northwest.

Figure 4: A view of the Bluffs varying topography and drainage network.

Figure 5: A bird’s-eye view of the Baumgartner Property.
An Important Resource

In an effort to understand this important recreational and natural resource, the multi-disciplinary design team, which included an ecologist, trails planner, landscape architects and civil engineers, visited Riverdale Bluffs to study the site’s topography, natural vegetation and recreation potential. Upon visiting the Bluffs, the site’s major recreation draw becomes clear. The tall bluffs and rolling hills welcome visitors and invite them to explore the variable landscape. The tall bluffs offers visitors dramatic views toward the South Platte River and the Riverdale Regional Park to the east, the downtown Denver skyline to the south, and the Rocky Mountain Front Range to the west. This site could become a regional destination for those looking to climb to the top of the main bluff and take in its tremendous views.

Through the analysis of the open space’s natural resources and recreational potential, spatial constraints onsite created a unique design challenge for the project team. At 226 acres, the site is approximately one mile across in the north-south direction, and of variable width in the east-west direction, but on average about a half mile wide. In some areas the site is only 900 feet wide—a distance of less than three football fields, which feels narrow in this wide-open prairie environment, especially with the encroaching residential subdivisions on each side of the open space. On the other hand, there are some very scenic areas of the site that provide an expansive open space experience, especially from a high point near the northwest limits of the site, and along the prominent drainage that traverses the south parcel, just west of the Baumgartner property.

After numerous visits to the site by the multi-disciplinary team, the initial vision of developing the site into a trails-focused recreational resource started to coalesce.

General guiding principles developed by the team for the master planning process included the following:

- **Facilitate appropriate recreational use:** Although a valuable natural resource, the Bluffs site has been severely degraded over the years, resulting in significant areas of disturbance, weeds, and erosion. It is not a pristine natural resource, and may take many decades to restore. Recreational trail use and other passive recreation that takes advantage of the unique high points, views, and rolling topography have been identified as appropriate uses for the site, but should be developed in a responsible manner that does not further degrade the resource;

- **Enhance regional connectivity:** Given the proximity of the Bluffs to the South Platte River and Greenway, and the future east-west E-470 trail, this open space can play a primary role in connecting the communities and neighborhoods that lie to the west of the South Platte River and Riverdale Road to the South Platte River Greenway. Creating better multi-modal connections to and from the Bluffs should be a priority;

- **Plan for diverse recreational amenities:** Ones that attract the residents of nearby neighborhoods as well as destination users from other parts of the County. Consider the potential use of the open space by students at the adjacent high school and middle school (cross country running, mountain biking, other academic-focused field trips). Create one-of-a-kind recreational attractions that are not available in other nearby areas;

- **Integrate improvements for the Bluffs open space with the newly acquired Baumgartner property to create a seamless open space experience;**

- **Develop a long-term approach to incrementally improve habitat and vegetation at the Bluffs.**

After performing the site analysis and developing the guiding objectives for the master plan, the team focused on conducting a robust public process that included two public meetings which engaged the public in assisting the team in the development of master plan recommendations for the site. Each public meeting featured a presentation of potential concepts for site improvements followed by an on-line opinion poll providing an opportunity to vote on their preferences. The public’s feedback was a primary resource that the team used to make decisions about what activities and improvements should be included in the master plan. (See the detailed description of the public process, and results of the public opinion polls in the appendix.)

Public Engagement

Figure 6: Viewshed looking southeast to primary drainage with main bluff on the left.

Figure 7: A view of the primary drainage way looking north.

Figure 8: Drainage way south of 136th Avenue.
Natural Resources Inventory

The Riverdale Bluffs site is characterized by steep bluffs above the South Platte River floodplain to the east, and gently rolling hills to the north that are intersected by multiple dry gullies. The site is dry and receives little runoff from onsite drainage basins. The low areas, drainage gullies and swales have more dense vegetative cover than the steeper slopes due to concentrations of moisture, however all but one of these “drainages” are dominated by upland species, with only one gully in the southwest corner of the property receiving enough precipitation runoff to support wetlands. The main central swale that runs northwest to southeast through the site has more notably lush vegetation than the adjacent slopes, and also supports some woody shrubs that are uncommon in the rest of the site.

The property is dominated by shortgrass prairie and mixed grassland communities, consisting of both native prairie species and abundant nonnative weed species. Higher quality grassland areas include the steep slopes of the main bluff on the east side of the property, and the gully in the northwest corner, which consist of higher-quality shortgrass prairie communities that are dominated by native prairie species. Species identified in the shortgrass prairie include: blue grama, buffalo grass, common sunflower, soapweed yucca, and prickly pear cactus. This plant community is pervaded by cheatgrass, a non-native invasive grass species that is present in a large portion of the site. Species that were observed within the mixed grassland vegetation community included blue grama, buffalo grass, soapweed yucca, sand dropseed, ring muhly, squirreltail, slimflower, scurpacea, purple prairie clover, hairy false goldenaster, common sunflower, prickly pear cactus, burningbush, winterfat, yellow rabbitbrush, and sand sagebrush. Weeds and invasive plants in this community include field bindweed, prickly Russian thistle, and cheatgrass.

There are only a few living trees on the site, the largest of which is located near the historic entrance gate at the northeast corner adjacent to Riverdale Road. Given its location, this tree was likely planted by a previous land owner. The site has an extensive history of disturbance primarily due to energy extraction activities (oil & gas), uncontrolled recreation (off road vehicles use etc.), and previous use of the site as a private residence (since demolished). As a result, much of the original native grassland vegetation has been disturbed and taken over by noxious weeds. Soils are dominated by gravelly-sand and silty-clay soils, with high erodibility on excessive slopes. Erosion issues can be mitigated through proper trail design, construction, and management. These soils are also prone to severe rutting when they are wet, which can be problematic for trail management in the winter months, resulting in trail damage, trail widening and braiding, and degraded visitor experiences.

Note: A small colony of prairie dogs exist on the east side of the site just north of 136th Avenue. It will likely be impacted by proposed trailhead improvements.

Recommendations:

- Continue to control isolated patches of noxious weeds such as scotch thistle and common mullein with a variety of methods, including chemical herbicide and mechanical treatments. The objective should be to minimize the spread of these species within the site;
- Evaluate the options available for improving the coverage of native grass species and controlling cheatgrass. This weed species is difficult and expensive to control with chemical weed control, and mechanical control is not practical. While overseeding the site with more desirable grass species may have some benefit, the long-term history of weed proliferation has resulted in the development of a significant weed seed bank in the site soils that would be difficult to overcome without more aggressive (and expensive) methods, potentially including controlled burns, and/or replacement of topsoil;
- The site’s trails and recreational amenities should be located and designed to encourage visitors to use and stay on provided trails;
- Areas disturbed during the construction of site improvements, and other bare areas throughout the site should be seeded using best practices for soil preparation, seeding, mulching, and maintenance (including re-seeding if necessary). Seed mixes should consist of native prairie species that are appropriate for the site;
- All disturbed areas, including trail corridors, should be monitored for vegetation condition and noxious weeds for up to three years beyond construction. Any new noxious weed infestations should be aggressively controlled;
- Seeded areas steeper than 4(H):1(V) should be stabilized with erosion control blanket instead of mulch;
- Identify opportunities for small-scale, experimental restoration of native grassland species on the site, using a combination of mechanical and chemical treatments, drill seeding, overseeding, and monitoring. If successful, these methods could be used at a larger scale to work towards large patches of native prairie within the open space;
- Consider management measures to reduce trail damage during wet conditions, including a light crusher-fine overlay of trails during construction, and/or trail closures during extended wet conditions (typically in winter).
Riverdale Bluffs Vision

With the completion of the Site Analysis, the development of the project Design Principles, and the feedback received from the Public Engagement Process, a vision of Riverdale Bluffs began to emerge as an open space oriented around a diverse network of trails connecting users across the site to overlooks and open space amenities. The site’s terrain offers the chance to provide a variety of trail types for users of all ages and abilities. The vision included ADA accessible walking trails, stair climbing trails, soft surface running trails, mountain biking downhill trails, and kids biking loops.

The majority of the trails at the Bluffs were envisioned to be local trails, designed to move users through, over and around the rolling Bluffs landscape. However, through a recently emerging partnership opportunity, an important regional trail connection will also be part of the Riverdale Bluffs recreational experiences. This trail is the E-470 Regional Trail, which had long been planned by the E-470 Authority to parallel the E-470 highway along the northern boundary of the Riverdale Bluffs property. Through a partnership between E-470 and Adams County, the trail will now be routed through the Bluffs, providing very significant regional trail connections between the Bluffs and the South Platte Greenway to the east, and in the future, to Thornton, and the quickly growing neighborhoods to the west.

The proposed E-470 trail will cross the site from the northwest corner to the southeast corner near Riverdale Road and 136th. It will traverse the northern edge of the site before turning south and passing along the south side of the main bluff, adjacent to the main Bluffs trailhead. Heading east, the trail will cross Riverdale Road via an overpass, and then will continue east on Adams County Open Space property to a junction with the South Platte Greenway. A feasibility study of the trail alignment through the Bluffs was performed by the master planning team, and found that the alignment of the E-470 trail through the Bluffs would not unduly impact the original vision of a trail oriented open space, as it is generally separate from the internal circulation routes. In addition, the paved regional trail will provide an important additional recreational amenity for the open space, and for the County recreational network as a whole. The proposed alignment of the E-470 trail through the Bluffs was approved by the E-470 Authority board, and subsequently an IGA has been developed between Adams County and the Authority to authorize Adams County to move forward with the design of this trail connection.
The vision for the Bluffs, that was approved by the public and Adams County staff, includes the following:

### Trails
- E-470 Trail with Soft Surface Shoulder
- Crusher Fines Trail
- Singletrack Trail
- Kids Skills Loop
- Stair Climber Trail

### Trailhead & Visitor Facilities
- Parking Lot
- Restrooms
- Picnic Areas & Shelters
- Signage & Kiosks

### Destination Overlooks
- Seating
- Overlook Shade Structure
- Interpretive Signage & Maps
- Pedestrian Overpass

*Equestrian use is allowed at all Adams County Open Spaces. No specific equestrian use only trails are proposed at Riverdale Bluffs but equestrian use is permitted on all primary soft surface trails and singletrack multi-use trails (with the exception of the soft surface trail to the bluff overlook, which includes stairs).
SITE PERSPECTIVES

1. Bluffs Overlook
2. Stair Climber Trail
Adams County, CO - Parks, Open Space, & Cultural Arts

DETAILED MASTER PLAN

Map Legend

- **E-470 REGIONAL TRAIL (10’ WIDE CONCRETE WITH 4’ SOFT SHOULDER)**
- **PRIMARY SOFT SURFACE TRAIL (6’ TO 10’ WIDE CRUSHER FINES)**
- **FUTURE SOFT SURFACE TRAIL (CONCEPTUAL)**
- **SINGLETRACK TRAIL - MULTI-USE (2’ TO 3’ WIDE, EARTHEN)**
- **SINGLETRACK TRAIL - PEDESTRIAN ONLY (2’ TO 3’ WIDE, EARTHEN)**
- **SINGLETRACK TRAIL - BICYCLE ONLY (2’ TO 3’ WIDE, EARTHEN)**
- **PROPERTY LINE**
- **CULVERT**
- **DRAINAGE WAY**
- **TRAIL SEGMENT DESCRIPTION - SEE PAGES 10 & 11**
- **INTERPRETIVE SIGN**
- **MOUNTAIN BIKE ONLY TRAIL**
- **SCENIC OVERLOOK**

Scale 1” = 300’
**TYPICAL TRAIL SECTIONS:**

- **Concrete**
- **Crusher Fines**
- **Compacted Subgrade**
- **Undisturbed Subgrade**

**SCALE: 1”=5’**

**Paved Multi-Use (Trails A1 & A2)**

**Trail A1: E-470 Regional Trail**
- **Type:** Concrete Paved Multi-Use Trail
- **Length:** 1.5 mile
- **Width:** 10’ wide with 4’ crusher fines shoulder
- **Difficulty:** Easy
- **Purpose:** Provides connection from 136th Avenue to Riverdale Bluffs Trailhead. Also creates connection to Riverdale Ridge High School, and Rodger Quist Middle School.

**Design + Construction Considerations:**
- Requires pedestrian overpass crossing at Riverdale Road;
- Trail to be ADA accessible throughout;
- Wherever possible, trail should meet AASHTO trail standards for design speed, radii, shoulder widths, railings, warning and wayfinding signage etc.;
- Provide culverts to manage drainage across trail;
- Alignment needs to be coordinated with other open space trails for safety and to minimize short-cutting.

**Trail A2 + A3: Trail to 136th Ave / Adjacent Neighborhood**
- **Type:** Concrete Paved (A2) / Soft Surface Connection Trail (A3)
- **Length:** 0.7 mile
- **Width:** 6’ wide
- **Difficulty:** Easy
- **Purpose:** Provides connection from 136th Avenue to Riverdale Bluffs Trailhead. Also creates connection to Riverdale Ridge High School, and Rodger Quist Middle School.

**Design + Construction Considerations:**
- Will require an underpass crossing of 136th Ave;
- During final design, a detailed evaluation of the flood flows over-topping 136th Avenue will be required to properly design trail crossing over tributary in a manner to not worsen existing conditions for flooding of 136th Avenue during large rain events;
- Provide culverts for drainage flows in minor gullies crossing trail alignment and for managing concentrated cross drainage;
- Trail should be designed to interface/connect with parking lot on the Baumgartner Property;
- Trail to be ADA accessible throughout;
- Wherever possible, trail should meet AASHTO trail standards for design speed, radii, shoulder widths, railings, warning and wayfinding signage etc.;
- Alignment needs to be coordinated with other open space trails for safety and to minimize short-cutting;
- Potential future repaving of crusher fines segment (A3) in concrete it trail receives high traffic from adjacent neighborhoods.

**Trail B1: Bluff Access Trail**
- **Type:** Soft Surface Trail
- **Length:** 5 mile
- **Width:** 10’-12’ wide
- **Difficulty:** Easy
- **Purpose:** Provides an easy route to the top of the bluff from the E-470 Trail for pedestrians and bikers. Also provides vehicle access for maintenance and special events. Is an alternative for those who do not want to climb the stair-step trails that ascend the southwestern side of the bluff from the trailhead, and can also be combined with the stair stopper routes for intensive training (running up stair steps, descending down the trail).

**Character:** Wide, pedestrian-friendly, soft surface trail to dramatic overlooks. Will likely be one of the most highly-used trails in the open space.

**Design + Construction Considerations:**
- Trail to be ADA accessible;
- Needs to accommodate maintenance vehicle access;
- Signage to instruct bikers to use slow speed may be required.

**Trail B2: Sunflower Loop**
- **Type:** Soft Surface Trail (with possible adjacent singletrack secondary trail)
- **Length:** 0.5 mile
- **Width:** 6’8”
- **Difficulty:** Easy
- **Purpose:** Provides a short and gentle walking loop for casual visitors using the E-470 Trail. Provides access to Trail B3 that climbs up to the northwestern ridge of Riverdale Bluffs, with views to the mountains to the west.

**Character:** A pleasant, soft surface path wide enough for 2 or 3 people to walk side by side. The loop is situated on a saddle and offers views in many directions, and is named after the many sunflowers that bloom in the native grass areas in the summer.

**Design + Construction Considerations:**
- Crushed fines paving (or similar);
- ADA accessible trail if possible.

**Trail B3: Future Yosemite Entry Trail**
- **Type:** Soft Surface Trail
- **Length:** 3 mile
- **Width:** 6’8” wide
- **Difficulty:** Easy
- **Purpose:** Provides a short out-and-back from Sunflower Loop (Trail B2) to the northwestern ridge, and future connection to Yosemite Street if/when Yosemite becomes a public street.

**Character:** A soft surface path wide enough for 2 or 3 people to walk side by side. Bicycle use should be approved, but managed (open to kids on bikes, but designed to not be an attraction for most mountain bikers). Good location for dispersed seating and interpretive signage along trail. Could potentially be used by bikers instead of adjacent single-track trails during soggy conditions.

**Design + Construction Considerations:**
- Crushed fines paving (or similar);
- ADA accessible trail if possible.

**Trail B4: Baumgartner Saddle Trail**
- **Type:** Soft Surface Trail
- **Length:** 800 feet
- **Width:** 3’-6”
- **Difficulty:** Easy to Moderate
- **Purpose:** Provides access from lower south parking to the Baumgartner residence as an alternative to stairs or the driveway. Also provides access from the Baumgartner residence to the Bluffs trail network.

**Character:** A narrower soft surface path wide enough for 2 people to walk side by side. Excellent views to open space and distant views of downtown Denver to the south and southeast. Intended to be a rustic pedestrian-oriented trail.

**Design + Construction Considerations:**
- Trail will have about an 8% slope;
- Consider how trail will interface with parking area and natural surface trails. Locate trail to discourage short-cutting to C6;
- Possibly align trail adjacent to driveway as a “soft-sidewalk” to provide secondary access to the Baumgartner residence and reduce exploration of this trail by other trail users;
- Grade exceeds limits of typical “crusher-fine” surface; assess other soil blends for improved durability.

**Trail C1: Singletrack Trail**
- **Type:** Singletrack – Multi-use
- **Length:** 0.8 mile
- **Width:** 30’-36”
- **Difficulty:** Easy
- **Purpose:** Provides a short loop near the trailhead with a true “trail” experience vs the concrete or crusher fine paths.

**Character:** Typical front-country singletrack. Design for multi-use with occasional passing zones. Allow obstacles and protrusions only where cross-slope is sufficient to prevent braiding.

**Design + Construction Considerations:**
- Careful design will be required to manage user conflicts at intersections and nodes interfacing with the Bike Skills Loops. The southern 1/3 of trail will likely need to be elevated and have puncheons and/or timber-culverts to accommodate runoff from large storms;
- Northern segment of trail parallels walking-oriented Trail B2 (Sunflower Loop) to provide continuous riding experience, and prevent user conflicts. This segment is located on fairly flat terrain, so surfacing material may need to be thicker and more crowned/sloped than usual to adequately drain. Anticipated lift-n-fill construction with native soil base and all-weather (imported material) top layers.
- Co-locate intersections with Trails B2 and C3 to reduce number of intersections and related wayfinding signage needs.

**Trail C2: Singletrack Trail**
- **Type:** Singletrack – Multi-use
- **Length:** 0.2 mile
- **Width:** 24’-30”
- **Difficulty:** Easy
- **Purpose:** Provides a short loop near the trailhead with a true “trail” experience vs the concrete or crusher fine paths.

**Character:** Typical front-country singletrack. Design for multi-use with occasional passing zones. Allow obstacles and protrusions where cross-slope is sufficient to prevent braiding.

**Design + Construction Considerations:**
- Careful design will be required to minimize short-cutting at the southeast end.
Trail C3: Singletrack Trail
Type: Singletrack – Multi-use
Length: 1.2 miles
Width: 18-30”
Difficult: Intermediate
Purpose: Provides access and re-access to the Trail D1 (downhill) mountain bike experience.
Character: Typical front-country singletrack. Design for multi-use with occasional passing zones. Allow obstacles and protrusions only where cross-slope is sufficient to prevent braiding. Utilize topographic undulations to reduce bike speeds and influence viewsheds.
Design + Construction Considerations:
- Locate to utilize cross-slopes for drainage and reducing trail widening. Match curvature to natural flow unless sufficient anchors exist to prevent braiding.

Trail C4: Singletrack Trail
Type: Singletrack – Multi-use
Length: 1.2 miles
Width: 18-30”
Difficult: Intermediate
Purpose: Connects Trails C3 to D3. Provides access to high point viewsheds.
Character: Design for multi-use with occasional passing zones. Allow obstacles and protrusions only where cross-slope is sufficient to prevent braiding. Utilizes topographic undulations to reduce bike speeds and influence viewsheds.
Design + Construction Considerations:
- Locate to utilize cross-slopes for drainage and reducing trail widening. Match curvature to natural flow unless sufficient anchors exist to prevent braiding.

Trail C5: Singletrack Trail
Type: Singletrack – Multi-use
Length: 6 miles
Width: 24-30”
Difficult: Easy
Purpose: Combined with Trail C1, this trail creates a ~1.4-mile loop immediately accessible from the trailhead. Paired with trail to the north, it provides a 3 + mile loop.
Character: Typical front-country singletrack. Design for multi-use with occasional passing zones. Allow obstacles and protrusions only where cross-slope is sufficient to prevent braiding. Create enough curvature and undulation to reduce bike speeds.
Construction Considerations:
- The southern portion should be sited to be inopsicus from the concrete path and use micro-topography to achieve drainage. This trail will need a short spur to the concrete path near the underpass.

Trail C6: Singletrack Trail
Type: Singletrack – Multi-use
Length: 6 miles
Width: 30-36”
Difficult: Easy
Purpose: This serves as the primary natural surface trail on the south side of 136th and is accessible from the Baumgartner residence.
Character: Typical front-country singletrack. Design for multi-use with occasional passing zones. Allow obstacles and protrusions only where cross-slope is sufficient to prevent braiding. Utilize topographical undulations for drainage and to create a rolling character that reduces bike speeds.
Design + Construction Considerations:
- Roadway design will be required to manage congestion at intersections and nodes interfacing with the southern trailhead and underpass. Sloughing soils may influence tread width.

Trail C7: Singletrack Trail
Type: Singletrack – Multi-use
Length: .7 mile
Width: 18-24”
Difficult: Intermediate
Purpose: This is the western half of the main loop on the south parcel. (Combined with the trail C8C it forms a loop of just over 1.3 miles long.) Combined with the terrain from the high school making it a likely candidate for short field trips, and training opportunity for high school running or biking teams.
Character: Typical front-country singletrack. Design for multi-use with occasional passing zones. Allow obstacles and protrusions only where cross-slope is sufficient to prevent braiding. Create enough curvature and undulation to reduce bike speeds.
Construction Considerations:
- This loop has 2 crossings of a significant drainage tributary that can have significant flows during rain events. These crossings should be reinforced (or should utilize culverts) to withstand anticipated food flows.
- Match curvature to natural flow unless sufficient anchors exist to prevent braiding.

Trail C8: Singletrack Trail
Type: Singletrack – Pedestrian Only
Length: .95 miles
Width: 24-36”
Difficult: Moderate
Purpose: Provides pedestrian only access to the high point at the north end of the property. Would reduce user conflicts for those wishing to climb to the top of the bluff from the B3 trail and future Yosmite Road connection.
Character: A narrower singletrack trail with excellent views to open space and E-470. Intended to be a rustic pedestrian-oriented trail.
Design + Construction Considerations:
- Trail will have about an 8% slope.
- Typical front-country single track.

Trail D1: Difficult Downhill Track
Type: Mountain Bike Optimized (downhill only)
Length: .5 mile
Width: 24-48”
Difficult: Intermediate with Difficult options
Purpose: Provide an intermediate-level mountain bike optimized experience where cyclists can improve skills; easily “sessioned” by climbing the south end of C5. Provides the final descent at the end of a ride where cyclists can enjoy speed/challenge without worrying about conflict with hikers or uphill traveling cyclists.
Character: Bike-optimized front-country singletrack. A flowing, serpentine trail with natural and constructed berms, small earthen jumps and gully crossings. Several OTFs of no more than Intermediate and Intermediate+ difficulty; all rollable, no gaps, long transition zones.
Design + Construction Considerations:
- Use the gully to constrain the area, provide drainage and create a serpentine rhythm. Reduce bottom and tight curves near bottom for speed control before intersection.

Trail D2: Intermediate Downhill Track
Type: Mountain Bike Optimized (downhill only)
Length: 2.5 miles
Width: 24-48”
Difficult: Easy + with Intermediate + options
Purpose: Provides a beginner-level mountain bike optimized experience where cyclists can improve skills; easily “sessioned” by climbing the south end of C5. Provides the final descent at the end of a ride where cyclists can enjoy speed/challenge without worrying about conflict with hikers.
Character: Bike-optimized front-country singletrack. A flowing, serpentine trail with natural and constructed berms, small earthen jumps and gully crossings. Several OTFs of no more than Intermediate and Intermediate+ difficulty; all rollable, no gaps, long transition zones.
Design + Construction Considerations:
- Use the gully to constrain the area, provide drainage and create a serpentine rhythm. Reduce bottom and tight curves near bottom for speed control before intersection.

Trail K1: Skills Loop A
Type: Bicycle Skills Loop
Length: 1 mile
Width: 24-48”
Difficult: Novice
Purpose: Provide a facility for young kids and beginner adult riders to learn the basic skills of riding a bicycle on trails. Provides tightly incremental progression to develop foundational balance, coordination, operational familiarity and confidence on a bicycle. Design + Construction Considerations:
- Look to skills loop at Valmont Bike Park for a sample of skill building features, orientation, and fall-zones;
- Accessible from main parking area, but buffered for safety and comfort.

Trail K2: Skills Loop B
Type: Bicycle Skills Loop
Length: 4 mile in ~ 1.5 acres
Width: 24-48”
Difficult: Beginner
Purpose: Provide a facility for young kids and beginner adult riders to build up to the basic trail ridings skills developed in Loop A (K1). Create next-level incremental progression of balance, coordination, operational familiarit and confidence on a bicycle. Introduce cornering, line selection, weight shifts, additional texture, momentum skills and playful features.
Design + Construction Considerations:
- Look to dirt 101 and The Glades at Valmont Bike Park for a sample of skill-building features, orientation, and fall-zones;
- Accessible from C1 and A2, but buffered to not interfere with other visitors.

Trail S1: Stair Stepper Trail
Type: Soft Surface with Stair Stepper Trail (pedestrian use only)
Length: 350 feet
Width: 6-8”
Difficult: Easy - Moderate
Purpose: Provides a direct pedestrian route from main parking area/trailhead to top of bluff. Anticipated to be popular route for visitors who may not be typical open space trail users. Overlook at top of bluff provides exceptional views, interpretive signage, and seating. Stair-stoopers up the bluff also provides a unique training experience for visitors who are interested in “incline”-type fitness opportunity. Trail can be “sessioned” with Trail S2, or B1 + C2 to create training loops.
Design + Construction Considerations:
- Recommend stairs be constructed out of precast concrete stair units. (Refer to Stair-Stepper detail and perspective rendering). This is the less-steep of the 2 proposed Stair Stepper routes that will easily accommodate both uphill and downhill pedestrian use.
- Average slope is 4.8%. Need for hand railings is not anticipated, but should be further evaluated during final design.

Trail S2: Stair Stepper Trail
Type: Soft Surface with Stair Stepper Trail (pedestrian use only)
Length: 400 feet
Width: 6-8”
Difficult: Moderate
Purpose: Provides a direct pedestrian route from main parking area/trailhead to top of bluff. Anticipated to be popular route for tourists / visitors who may not be typical open space trail users. Stairs up the bluff also provides a unique training experience for visitors who are interested in “incline”-type fitness opportunity. Trail can be “sessioned” with Trail S1, or B1 + C2 to create training loops. Potential designation as “Uphill only” pedestrian route due to steepness of stair-stepper segment.
Design + Construction Considerations:
- Recommend stairs be constructed out of precast concrete stair units. (Refer to Stair-Stepper detail and perspective rendering). This is the steeper of the 2 Stair Stepper routes currently proposed, and may be challenging for downhill use. Maximum slope is 37%. Hand railings will likely be required, especially if downhill use is permitted. Further evaluation of stair location and construction will be required during final design.

Stair Axon for Trails S1 & S2
OPTIONAL TRAIL FEATURES

Optional Trail Features, or OTFs, are natural or man-made obstacles in the trail or alongside the trail that require bike handling skills to ride. OTFs are fun for riders and they provide skill building and progression opportunities. In the case of bridges, rollers, berms and rock armored trail, they can also serve to improve sustainability. They can range from easy to expert level, and are often opportunistic in that they take advantage of existing site elements and characteristics for much of, or part of, their challenge.

Identifying the best feature to develop along a trail route requires intimate knowledge of the terrain, the flow of the trail, and the “clientele,” or user group that will likely be using any particular feature in a particular location. As such, these features cannot be located or assigned during the master planning process, but need to occur during construction document development, or possibly during construction as design-build elements. The OTF images included on this page are to illustrate of the types of features that could be developed by the final designer for the Riverdale Bluffs Open Space.

DROPS AND JUMPS: These can be drops off of natural features, such as logs or rocks, or built-up elements such as decks, or tables. A jump has a positive take-off angle which sends the rider into the air. A drop has a flat or negative take-off angle so it sends the rider downward. The two require different skill and technique.

SKINNIES AND LOG RIDES: These elevated and narrow riding surfaces help to develop balance skills. These elements can be built from fallen trees, split logs, milled planks, or dimensional lumber. They can also be straight, curved, or angled.

BOARDWALKS AND LADDER BRIDGES: These features can be functional, i.e., to allow trail users to cross wet areas, but are also popular mountain bike trail features that can be built with varying width, twist and undulation.

ROLLOVERS: Fallen logs and boulders along a trail are common natural features, and can also be created in trail segments where they do not tend to naturally occur. These can also be developed in combinations or progressions that increase skill required to successfully negotiate the obstacle.

BANKED TURNS: These exciting and variable features can be built using earth or out of wood.
Appendix

Project Process i
Natural Resources Inventory ii
Site Tour v
Drainage Report vi
PROJECT PROCESS

Involvement of Adams County Staff and Stakeholders
To understand existing conditions and stakeholder’s concerns at the Bluffs, the consultant team conducted several information-gathering meetings and site visits with County representatives and key stakeholders. The first tier of stakeholders/interested parties engaged was staff with Adams County Open Space. Meetings were held on-site with the planning/design team and management team representatives. Staff members were able to provide clear objectives for the project and discuss feasibility of objectives with the design team. The consultant team then engage the public through public meetings and visitor survey (summary of meetings and survey results below). This public involvement strategy allowed each stakeholder group provided insight on their respective concerns and desires for the site.

1st Public Meeting
The consultant team worked with Adams County to develop an informative, virtual public meeting presentation (COVID-19 protocols required the meeting to be held virtually). The goal of the 1st meeting was to present initial site findings, from the consultants site visits and meetings with County staff, and gather stakeholder input on potential master plan improvement opportunities for the Bluffs. We presented on the background of the site and surrounding landscape, provided analysis of ecological features, and created a site tour, with viewsheds and drone imagery, to acquaint stakeholders with existing site features and proximity to other recreational amenities. The attendees were encouraged to participate in the Q&A portion of the presentation where they could engage with representatives from the design team and County officials. Meeting attendees were also given the opportunity to provide their input through an online survey.

Visitor Survey #1
The consultant team designed a brief visitor survey to collect feedback on what site improvements could be made, and what visitors would like to see at the Bluffs property. Over 50 people completed the survey, providing the consultant team with insight into the stakeholder’s concerns, and desires for the project area. The results from this survey helped inform the next phase of the master planning process.

Visitor Survey Results
Walking/hiking, running and biking were the most popular activities respondents wished to see at the Bluffs.

The following design elements would be viewed as a positive improvement by the majority of visitors:

- Adding small picnic areas rather than large, more intruding picnic area/structure;
- Providing more educational/interpretive signage & art;
- Ensure the natural prairie landscape and wildlife are protected.

The biggest concern with the development of the property is security for the users onsite and the surrounding neighborhoods.

Survey Results Summary

Development of Master Plan Alternatives
After the 1st Public meeting and receiving feedback from the visitor survey, the design team assessed the trail alignments, bluffs access across the site and opportunities to build upon regional connections. Through collaboration with stakeholders and other government & quasi-government agencies, the team developed options for the E-470 trail alignment, regional trail connectors and connections to local schools. The team also coordinated with the City of Thornton to investigate a functional pedestrian connection between Quebec and the South Platte River Greenway.

2nd Public Meeting
The goal of the 2nd public was meeting was to present master plan options for the Bluffs to the public. The meeting included a recap of the existing site conditions, site constraints, shared survey findings from the first public meeting. The consultants then shared recommendations for improvements in the area including trail alignments, visitor amenities and overall vision plan for the site. After the meeting, attendees were encouraged to provide their feedback on the master plan development through a link provided.

Second Public Meeting Comments
Overall, responses to the master plan components were positive. Most respondents commented wanting equestrian trails and access onsite.

Master Plan Refinement
After both public meetings, the consultant team refined the master plan to create a comprehensive plan that meets the needs of stakeholders, creates a safe and multifunctional recreation experience and protects the natural resources onsite.
TO: Paul Thomas, Stream Landscape Architecture
FROM: Marie Russo, ERO Resources Corporation
RE: Riverdale Bluffs Vegetation Assessment

Introduction
On September 15, 2020, ERO Resources Corporation (ERO) conducted a vegetation assessment, including noxious weeds identification, of the Riverdale Bluffs Open Space project area (2020 assessment) (Figure 1, project area). Riverdale Bluffs Open Space is an Adam County Open Space property and is roughly bounded by E-470 to the north, Riverdale Road to the east and south, and Yosemite Street to the west. The methods and results of the 2020 assessment are described below.

Methods
The 2020 assessment included visually assessing different vegetation communities and searching for noxious weed species listed on the Colorado Noxious Weed List (Colorado Department of Agriculture 2020). The vegetation communities and populations of noxious weeds found during the 2020 assessment were mapped on aerial photographs, as shown on Figure 2.

Results
Vegetation communities identified at Riverdale Bluffs Open Space include shortgrass prairie, mixed grassland, degraded grassland, and wetland/riparian.

Shortgrass Prairie
Species that were observed within the shortgrass prairie vegetation community included blue grama (Bouteloua gracilis), buffalo grass (Bouteloua dactyloides), cheatgrass (Bromus tectorum), common sunflower (Helianthus annuus), soapweed yucca (Yucca cf. glauca), and prickly pear cactus (Opuntia species).

Mixed Grassland
Species that were observed within the mixed grassland vegetation community included blue grama, buffalo grass, cheatgrass, soapweed yucca, sand dropseed (Sporobolus cryptandrus), ring muhly (Muhlenbergia torreyi), squirreltail (Elymus elymoides), slimflower scurfpea (Psoralidium tenuiflorum), purple prairie clover (Dalea purpurea), hairy false goldenaster (Heterotheca villosa), field bindweed (Convolvulus arvensis), common sunflower, prickly pear cactus, burningbush (Bassia scoparia), prickly Russian thistle (Salsola tragus), winterfat (Krascheninnikovia lanata), yellow rabbitbrush (Chrysothamnus viscidiflorus), and sand sagebrush (Artemisia cf. filifolia).

Degraded Grassland
The degraded grassland vegetation community was comprised of species such as sand dropseed, cheatgrass, common sunflower, field bindweed, hairy false goldenaster, burningbush, prickly Russian thistle, and crested wheatgrass (Agropyron cristatum).

Riparian/Wetland
The wetland/riparian vegetation community was comprised of species such as witchgrass (Panicum capillare), foxtail barley (Hordeum jubatum), western wheatgrass (Pascopyrum smithii), smooth brome (Bromus inermis), barnyardgrass (Echinochloa crus-galli), broadleaf cattail (Typha latifolia), and devil’s beggartick (Bidens frondosa).

Noxious Weeds
The entire property contains cheatgrass (List C species). Additional noxious weeds observed include common mullein (Verbascum thapsus, List C species), Scotch thistle (Onopordum acanthium, List B species), and field bindweed (Convolvulus arvensis, List C species).

In addition to the vegetation communities, two active prairie dog colonies were observed in the southern portion of the project area.

References

Attachments: Figures 1 and 2
Riverdale Bluffs Open Space Master Plan

Project Area

Prepared for: Adams County
File: 10859 Figure 1.mxd (GS)
October 5, 2020

Figure 1
Vicinity Map

Riverdale Bluffs Open Space Master Plan
Sections 22 and 27, T1S, R67W; 6th PM
UTM NAD 83: Zone 13N; 510660mE, 4421800mN
Longitude 104.875220°W, Latitude 39.946257°N
USGS Eastlake, CO Quadrangle
Adams County, Colorado

Prepared for: Adams County
File: 10859 Figure 2 Veg.mxd (GS)
October 5, 2020

Figure 2
Vegetation Communities

Riverdale Bluffs, CO Quadrangle
Adams County, Colorado

Prepared for: Adams County
File: 10859 Figure 3 mxd (GS)
October 5, 2020

Figure 3
Habitat Map

Adams County, CO - Parks, Open Space, & Cultural Arts
Figure 3
Soils

Riverdale Bluffs Open Space Master Plan

Adams County Parcel
Gravelly Sand Shale outcrop complex
Nunn clay loam, 1 to 3 percent slopes
Samsil Shingle complex, 3 to 35 percent slopes
Ulm loam, 3 to 5 percent slopes

Path: P:\10800 Projects\10859 - Riverdale Bluffs OS Master Plan\GIS\10859 Figure 3 Soils.mxd

Image Source: Google Earth©, September 2019

October 5, 2020
Prepared for: Adams County
File: 10859 Figure 3 Soils.mxd (GS)
SITE TOUR

1

2

3

4

5

6

7

8

9

10

Adams County, CO - Parks, Open Space, & Cultural Arts
Parking Lot Water Quality and Detention

A sand filter was conceptually sized to provide water quality and detention for the proposed parking lot. The 10-year peak is approximately 5 cfs. Where the regional detention basin was sized for the full impervious area of the parking lot. The Draft MDP shows this approximate 1-foot wide, 2.8-foot-deep channel with 4:1 side slopes and a 0.3% longitudinal slope would be required to verify infiltration rates and that the bedrock and ground water levels are greater than 5-feet deep.

The required detention volume is 0.22 acre-feet. A 3-foot deep sand filter with 4:1 side slopes (horizontal: vertical), which includes 1-foot of freeboard, would be constructed east of the proposed parking lot. The basin was sized for the full impervious area of the parking lot. Based on access from 136th Avenue, all of the flow will likely not be able to be conveyed to the sand filter. Efforts should be made in final design to convey as much water as possible from the parking lot to the sand filter. Conceptual calculations are attached.

Introduction

The purpose of this memorandum is to summarize the conceptual drainage design for the proposed Riverdale Bluffs parking lot and trail system located northwest of Riverdale Road and 136th Avenue in Adams County, Colorado. The proposed development for the site includes creating a trail system including hard and soft surface trails, connecting to the regional E-470 trail system. A parking lot will be constructed for the park, with access from 136th Avenue.

Trail Culverts

The Colorado Urban Hydrograph Procedure (CUHP) was used to analyze a representative basin to size culvert crossings for the 10-year storm event. The 10-year peak is approximately 5 cfs. Where the regional detention basin was sized for the full impervious area of the parking lot. The Draft MDP shows this approximate 1-foot wide, 2.8-foot-deep channel with 4:1 side slopes and a 0.3% longitudinal slope would be required to verify infiltration rates and that the bedrock and ground water levels are greater than 5-feet deep.

The concrete trail will also cross the South Platte River Northern Tributary 7, south of 136th Avenue. The South Platte River Northern Tributary 7 is currently a Zone A floodplain. This designation could change when the draft Flood Hazard Area Delinistration (FHAD) that is being completed by Olsson is ultimately submitted to FEMA in the future. The Brantner Gulch and Tributaries Draft Major Drainageway Plan prepared by Olsson in April 2020 (Draft MDP) shows a total future land use peak flow of 154 cfs in the 10-year storm event at Design Point S106T, just south of 136th Avenue. A 6-foot wide by 4-foot high reinforced concrete box culvert (RCBC) was conceptually sized to convey the 10-year flows under the trail. In existing conditions, 136th Avenue overtops. During final design, the floodplain impacts of the improvements should be evaluated to ensure that the overtopping condition on 136th Avenue is not adversely impacted by the proposed infrastructure.

Access Road Culvert and Channel Improvements

A natural drainage flows through the site toward the parking lot. The Draft MDP shows this approximate tributary area represented by Subbasin S04, with a 100-year peak flow of 92 cfs at Design Point S104. The existing drainage overtops Riverdale Road and 136th Avenue and are ill-defined east of Riverdale Road.

The drainage flows would be routed around the parking lot with minor grading improvements on the west side of the parking lot. Stormwater flows would then be routed under the access road in four 24-inch RCPs sized for the 100-year event of 92 cfs. Minor grading improvements are proposed to be completed to keep the flows east of the access road out of the parking lot, and then tie into existing conditions allowing flows to overtop 136th Avenue and Riverdale Road. To convey the 100-year flows of 92 cfs, a 6-foot wide, 2.8-foot-deep channel with 4:1 side slopes and a 0.3% longitudinal slope would be required. Additional depth would be required for freeboard.

To eliminate overtopping of Riverdale Road and 136th Avenue, drainage improvements would be needed downstream of Riverdale Road as well as completing channel improvements upstream of Riverdale Road to prevent overtopping. Improvements to cross the Brantner Ditch would also be required. An alternative that could be considered in final design would be to install a box culvert and fill in the bottom of the culvert to support future improvements at Riverdale Road. An 8-foot wide by 2-foot high RCBC would provide adequate capacity for the interim park conditions. If, and when, a culvert is installed to convey flows across Riverdale Road, a channel could be constructed, and the bottom of the culvert would be opened so additional infrastructure at the access road would not be required.
Vehicular Access Considerations

The parking lot to the Riverdale Bluffs property is planned to have vehicular access from 136th Avenue at a new access point located approximately 250 feet west of Riverdale Road. This section of the memorandum summarizes the requirements related to the location and configuration of the access and any additional improvements that may be needed for the planned driveway.

This section of 136th Avenue is not classified in any street map of Adams County, so it is assumed to be considered a rural highway. It is a two-lane road with a posted speed of 35 mph and no turn (auxiliary) lanes near the proposed site. The Adams County access standards are generally aligned with the State Highway Access Code would result in a R-B classification. This is a rural highway with moderate to high speeds and low volumes. In this scenario full-movement access is appropriate to a parcel if appropriate spacing from other access points or intersections and sight distance can be achieved.

Spacing on a R-B highway shall be at the sight distance for the roadway, which is 250 feet based on the posted speed of 35 mph. As final design is completed, this distance should be maintained (measure between the ends of curb returns).

Speed change or auxiliary lanes are required for left turn lanes when the turning volume is greater than 25 vehicles per day (vph) and for right turn lanes when the volume is greater than 50 vph. Based on the proposed size of the park (225 acres) and rates found in the ITE Trip Generation Manual for a Public Park (LUC 411), it would be expected that a typical weekday peak hour would attract approximately 22 inbound trips and the typical weekend peak would attract inbound 35 trips. Depending on the distribution of those trips, from the east or the west, it is possible that the left-turning inbound traffic would exceed the 25 vph threshold. There is an exception for the turn lane requirement for when the adjacent thru volume is less than 150 vph. Additionally, it is possible that another parking lot would be constructed in the future when the full traffic volume generation is being produced which could further dissipate turning traffic. All this discussion is to say that as the site plan is finalized it may be appropriate to verify the need for auxiliary lanes with a detailed impact analysis. Further coordination with Adams County should be performed to determine if this is required.

References


Attachments

Hydrologic Soils Group Map

MHFD Detention Calculations – Sand Filter

Culvert Capacity Calculations

Channel Calculations
Hydrologic Soil Group

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.


Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Adams County Area, Parts of Adams and Denver Counties, Colorado
Survey Area Data: Version 18, Aug 31, 2021
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.
Date(s) aerial images were photographed: Oct 3, 2018—Dec 4, 2018
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

### Map Legend

- **A**
- **B**
- **C**
- **D**
- A/D
- B/D
- C/D
- Not rated or not available

### Map Information

**Area of Interest (AOI)**

**Soils**

- **A**
- **B**
- **C**
- **D**
- A/D
- B/D
- C/D
- Not rated or not available

**Water Features**

- Streams and Canals

**Transportation**

- Railways
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

- Aerial Photography

---

<table>
<thead>
<tr>
<th>Map unit symbol</th>
<th>Map unit name</th>
<th>Rating</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gr</td>
<td>Gravelly land-Shale outcrop complex</td>
<td>A</td>
<td>259.0</td>
<td>26.5%</td>
</tr>
<tr>
<td>Lu</td>
<td>Loamy alluvial land</td>
<td>B</td>
<td>23.9</td>
<td>2.4%</td>
</tr>
<tr>
<td>Lw</td>
<td>Loamy alluvial land, moderately wet</td>
<td>C</td>
<td>27.4</td>
<td>2.8%</td>
</tr>
<tr>
<td>MISLD</td>
<td>Gravel pits</td>
<td>A</td>
<td>78.5</td>
<td>8.0%</td>
</tr>
<tr>
<td>NuB</td>
<td>Nunn clay loam, 1 to 3 percent slopes</td>
<td>C</td>
<td>55.0</td>
<td>5.6%</td>
</tr>
<tr>
<td>PB</td>
<td>Platner loam, 0 to 3 percent slopes</td>
<td>C</td>
<td>36.8</td>
<td>3.8%</td>
</tr>
<tr>
<td>ReD</td>
<td>Renohill loam, 3 to 9 percent slopes</td>
<td>D</td>
<td>34.8</td>
<td>3.6%</td>
</tr>
<tr>
<td>ShF</td>
<td>Samsil-Shingle complex, 3 to 35 percent slopes</td>
<td>D</td>
<td>376.2</td>
<td>38.5%</td>
</tr>
<tr>
<td>UIC</td>
<td>Ulm loam, 3 to 5 percent slopes</td>
<td>C</td>
<td>76.0</td>
<td>7.8%</td>
</tr>
<tr>
<td>U_ID</td>
<td>Ulm loam, 5 to 9 percent slopes</td>
<td>C</td>
<td>7.0</td>
<td>0.7%</td>
</tr>
<tr>
<td>W</td>
<td>Water</td>
<td></td>
<td>2.2</td>
<td>0.2%</td>
</tr>
<tr>
<td>W1</td>
<td>Wet alluvial land</td>
<td>D</td>
<td>1.1</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

**Totals for Area of Interest**

977.9 100.0%
Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition
Component Percent Cutoff: None Specified
Tie-break Rule: Higher
Pipe ID: Riverdale Bluffs Trails

**Design Information:**
- **Pipe Invert Slope:** So = 0.0100 ft/ft
- **Pipe Manning’s n-value:** n = 0.0150
- **Pipe Diameter:** D = 18.00 inches
- **Design discharge:** Q = 5.00 cfs

**Full-Flow Capacity (Calculated):**
- **Full-flow area:** Af = 1.77 sq ft
- **Full-flow wetted perimeter:** Pf = 4.71 ft
- **Half Central Angle:** Theta = 3.14 radians
- **Full-flow capacity:** Qf = 9.13 cfs

**Calculation of Normal Flow Condition:**
- **Half Central Angle (0<Theta<3.14):** Theta = 1.63 radians
- **Top width:** Tn = 1.50 ft
- **Wetted perimeter:** Pn = 2.44 ft
- **Flow depth:** Yn = 0.79 ft
- **Flow velocity:** Vn = 5.28 fps
- **Discharge:** Qn = 5.00 cfs
- **Percent of Full Flow:** 34.8% of full flow
- **Normal Depth Froude Number:** Fr = 1.17 supercritical

**Calculation of Critical Flow Condition:**
- **Half Central Angle (0<Theta<=3.14):** Theta-c = 1.72 radians
- **Critical flow area:** Ac = 1.05 sq ft
- **Critical top width:** Tc = 1.48 ft
- **Critical flow depth:** Yc = 0.86 ft
- **Critical flow velocity:** Vc = 4.17 fps
- **Critical Depth Froude Number:** Fr = 1.00

**Design Information (Input):**
- **Circular Culvert:** Barrel Diameter in Inches D = 36 inches
- **Box Culvert:**
  - **Barrel Height (Rise) in Feet:** H = R
  - **Barrel Width (Span) in Feet:** W = R

MHFD-Culvert_v4.0-Trails.xlsm, Pipe 1/14/2022, 7:21 AM

Adams County, CO - Parks, Open Space, & Cultural Arts
CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

**MHFD-Culvert, Version 4.00 (May 2020)**

**Project:** Riverdale Bluffs Master Plan (020-18010)

**Pipe ID:** North of 136th Ave Proposed Culvert - RCPs

### Design Information (Input)

- **Pipe ID:**
- **Pipe Diameter (D):** 24.00 inches
- **Pipe Manning’s n-value (n):** 0.0150
- **Pipe Invert Slope:** So = 0.0140 ft/ft
- **Design discharge:** Q = 23.00 cfs

### Full-Flow Capacity (Calculated)

- **Full-flow area (Af):** 3.14 sq ft
- **Full-flow wetted perimeter (Pf):** 6.28 ft
- **Half Central Angle (Theta):** 3.14 radians
- **Full-capacity (Qf):** 23.26 cfs

### Calculation of Normal Flow Condition

- **Half Central Angle (0<Theta<3.14):** Theta = 2.24 radians
- **Top width (Tn):** 1.57 ft
- **Wetted perimeter (Pn):** 4.48 ft
- **Flow depth (Yn):** 1.62 ft
- **Flow velocity (Vn):** 8.44 fps
- **Discharge (Qn):** 23.00 cfs

### Calculations of Culvert Capacity (output)

#### Backwater calculations required to obtain Outlet Control Flowrate when **HWo** < 0.75 * Culvert Rise

<table>
<thead>
<tr>
<th>Surface Elev.</th>
<th>Tailwater Elev.</th>
<th>Inlet Control</th>
<th>Inlet Controlling Flowrate</th>
<th>Outlet Control</th>
<th>Outlet Controlling Flowrate</th>
<th>Flow Rate Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headwater</td>
<td>Tailwater</td>
<td>Inlet</td>
<td>Inlet</td>
<td>Outlet</td>
<td>Outlet</td>
<td>Flow Rate Used</td>
</tr>
<tr>
<td>Elev. (ft)</td>
<td>Elev. (ft)</td>
<td>Equation</td>
<td>(cfs)</td>
<td>Equation</td>
<td>(cfs)</td>
<td>(cfs)</td>
</tr>
<tr>
<td>5023.00</td>
<td>5025.00</td>
<td>未定義</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>5024.00</td>
<td>5026.00</td>
<td>17.00</td>
<td>59.00</td>
<td>59.00</td>
<td>59.00</td>
<td>59.00</td>
</tr>
<tr>
<td>5025.00</td>
<td>5027.00</td>
<td>91.72</td>
<td>91.72</td>
<td>91.72</td>
<td>91.72</td>
<td>91.72</td>
</tr>
</tbody>
</table>

**Processing Time:** 00.10 Seconds

---

**MHFD-Culvert_v4.0 - Pipes - Access.xlsm, Pipe 1/14/2022, 2:25 PM**

---

Adams County, CO - Parks, Open Space, & Cultural Arts
Design Information (Input):

- Box conduit invert slope: \( S_o = 0.0100 \) ft/ft
- Box Manning’s n-value: \( n = 0.0100 \)
- Box Width: \( W = 8.00 \) ft
- Box Height: \( H = 2.00 \) ft
- Design discharge: \( Q = 92.00 \) cfs
- Full-flow area: \( A_f = 16.00 \) sq ft
- Channel Manning’s n-value: \( n = 0.0150 \)
- Critical flow depth: \( Y_c = 1.60 \) ft

Calculations of Normal Flow Condition:

- Normal flow depth \((r < H)\): \( Y_n = 1.21 \) ft
- Flow area: \( A_n = 9.71 \) sq ft
- Wetted perimeter: \( P_n = 10.43 \) ft
- Flow velocity: \( V_n = 9.47 \) fps
- Discharge: \( Q_n = 92.00 \) cfs
- Percentage of Full Flow: \( Q_n / Q_f = 67.2\% \)
- Normal Depth Froude Number: \( F_{n} = 1.52 \) supercritical

Calculations of Critical Flow Condition:

- Critical flow depth: \( Y_c = 1.60 \) ft
- Critical flow area: \( A_c = 12.83 \) sq ft
- Critical flow velocity: \( V_c = 7.18 \) fps
- Critical Depth Froude Number: \( F_{n} = 1.00 \)
**Channel Calculations**

<table>
<thead>
<tr>
<th>Description</th>
<th>100-Year Design Flow</th>
<th>Depth</th>
<th>Slope</th>
<th>Left Side Slope</th>
<th>Right Side Slope</th>
<th>Bottom Width</th>
<th>Manning’s n</th>
<th>Capacity</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel - S104</td>
<td>92.00</td>
<td>92.00</td>
<td>2.8</td>
<td>0.0003</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>0.06</td>
<td>51.67</td>
</tr>
</tbody>
</table>

\[ Q = VA = \left(\frac{1.49}{n}\right)AR^{\frac{3}{2}}/S \]
**MASTER PLAN COST OPINION FOR:**
Adams County - Riverdale Bluffs

**Master Plan**
TOTAL $8,064,295.64
August 12, 2022

**SUBTOTAL (NO CONTINGENCY)**
$6,360,571.21

**TOTAL**
$1,703,724.43

<table>
<thead>
<tr>
<th>Description</th>
<th>Bid Quant.</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BASE BID</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trailhead Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRAILHEAD AREA</td>
<td>1 LS</td>
<td>S</td>
<td>280,000.00</td>
<td>$280,000.00</td>
</tr>
<tr>
<td>Mobilization, Survey, &amp; Erosion Control</td>
<td>1 LS</td>
<td>S</td>
<td>330,000.00</td>
<td>$330,000.00</td>
</tr>
<tr>
<td>Site Trenching, Excavation, &amp; Dewatering</td>
<td>1 LS</td>
<td>S</td>
<td>220,000.00</td>
<td>$220,000.00</td>
</tr>
<tr>
<td>Clean-up &amp; Grading</td>
<td>1 LS</td>
<td>S</td>
<td>330,000.00</td>
<td>$330,000.00</td>
</tr>
<tr>
<td>Parking Lot, Shrub &amp; Grass Planting</td>
<td>1 LS</td>
<td>S</td>
<td>330,000.00</td>
<td>$330,000.00</td>
</tr>
<tr>
<td>Trailhead Paving</td>
<td>1 LS</td>
<td>S</td>
<td>330,000.00</td>
<td>$330,000.00</td>
</tr>
<tr>
<td>Picnic Area</td>
<td>1 EA</td>
<td>S</td>
<td>220,000.00</td>
<td>$220,000.00</td>
</tr>
<tr>
<td>Double Vault Toilet</td>
<td>1 LS</td>
<td>S</td>
<td>95,000.00</td>
<td>$95,000.00</td>
</tr>
<tr>
<td>Trailhead Kiosk</td>
<td>1 EA</td>
<td>S</td>
<td>20,000.00</td>
<td>$20,000.00</td>
</tr>
<tr>
<td>Gateway Signage</td>
<td>1 EA</td>
<td>S</td>
<td>20,000.00</td>
<td>$20,000.00</td>
</tr>
<tr>
<td>Park ID Signage</td>
<td>3 EA</td>
<td>S</td>
<td>14,000.00</td>
<td>$42,000.00</td>
</tr>
<tr>
<td>Benches</td>
<td>3 EA</td>
<td>S</td>
<td>2,000.00</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>Site Boulders</td>
<td>8 EA</td>
<td>S</td>
<td>650.00</td>
<td>$5,200.00</td>
</tr>
<tr>
<td>Electrical + Site Lighting at Parking Lot</td>
<td>2 EA</td>
<td>S</td>
<td>12,500.00</td>
<td>$25,000.00</td>
</tr>
<tr>
<td>Entry Road Drainage Culverts &amp; Headwall</td>
<td>1 LS</td>
<td>S</td>
<td>89,700.00</td>
<td>$89,700.00</td>
</tr>
<tr>
<td>Drainage Improvements + Water Quality</td>
<td>1 LS</td>
<td>S</td>
<td>144,900.00</td>
<td>$144,900.00</td>
</tr>
<tr>
<td>Landscaping, Soil Prep, and Fine Grading</td>
<td>98,362 SF</td>
<td>$4.00</td>
<td>$393,448.00</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>$1,251,009.78</td>
</tr>
<tr>
<td><strong>TRAIL SYSTEM (excluding E-470 trail)</strong></td>
<td></td>
<td></td>
<td></td>
<td>$3,430,462.30</td>
</tr>
<tr>
<td>Mobilization, Survey, &amp; Erosion Control</td>
<td>1 LS</td>
<td>S</td>
<td>330,000.00</td>
<td>$330,000.00</td>
</tr>
<tr>
<td>Site Trenching, Excavation, &amp; Dewatering</td>
<td>1 LS</td>
<td>S</td>
<td>220,000.00</td>
<td>$220,000.00</td>
</tr>
<tr>
<td>Trailhead Paving</td>
<td>1 LS</td>
<td>S</td>
<td>330,000.00</td>
<td>$330,000.00</td>
</tr>
<tr>
<td>Trail East</td>
<td>1 LS</td>
<td>S</td>
<td>1,786 CY</td>
<td>$25,004.00</td>
</tr>
<tr>
<td>Trail West</td>
<td>1 LS</td>
<td>S</td>
<td>13,644 CY</td>
<td>$245,592.00</td>
</tr>
<tr>
<td>Riverdale Rd Pedestrian Overpass</td>
<td>1 LS</td>
<td>S</td>
<td>920,000.00</td>
<td>$920,000.00</td>
</tr>
<tr>
<td>Concrete Paving - Trail in Riverdale Bluffs</td>
<td>1 LS</td>
<td>S</td>
<td>86,680 SF</td>
<td>$1,040,160.00</td>
</tr>
<tr>
<td>Crusher Fines Shoulder</td>
<td>34,672 SF</td>
<td>$4.50</td>
<td>$156,024.00</td>
<td></td>
</tr>
<tr>
<td>Concrete Paving - Trail East of Riverdale</td>
<td>32,140 SF</td>
<td>$12.00</td>
<td>$385,680.00</td>
<td></td>
</tr>
<tr>
<td>Drainage Crossings: 18-inch RCP</td>
<td>112 LF</td>
<td>$150.00</td>
<td>$16,800.00</td>
<td></td>
</tr>
<tr>
<td>Drainage Crossings: 18 inch FES and Toewall</td>
<td>14 EA</td>
<td>$2,875.00</td>
<td>$40,250.00</td>
<td></td>
</tr>
<tr>
<td>Drainage Crossings: 18 inch FES and Trashrack</td>
<td>14 EA</td>
<td>$2,300.00</td>
<td>$32,200.00</td>
<td></td>
</tr>
<tr>
<td>Drainage Crossings: Riprap Outlet Protection</td>
<td>9 EA</td>
<td>$805.00</td>
<td>$7,245.00</td>
<td></td>
</tr>
<tr>
<td>Site Trenching</td>
<td>133,580 SF</td>
<td>$0.45</td>
<td>$60,011.00</td>
<td></td>
</tr>
<tr>
<td>Landscaping, Soil Prep, and Fine Grading</td>
<td>115,580 SF</td>
<td>$0.45</td>
<td>$52,011.00</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>$4,691,538.80</td>
</tr>
</tbody>
</table>

Adams County, CO - Parks, Open Space, & Cultural Arts