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TASK MEMORANDUM

DATE:	November 21, 2024
TO:	TAC and Board of Directors, CCBWQA Jane Clary, Wright Water Engineers, CCBWQA Technical Manager
CC:	Cherry Creek State Park (CCSP) Park Manager
FROM:	Ricardo Gonçalves, PE
SUBJECT:	2024 Annual Inspection of Pollution Reduction Facilities (PRFs) at CCSP

Introduction

The CCBWQA has a contractural agreement with RG and Associates, LLC to perform a Field Observation annually of the PRFs constructed by the CCBWQA at CCSP, and to perform observations on those PRFs after a storm event of more than 1" per hour of intensity or reported visible damage to PRF facilities in the CCSP.

The purpose of the annual Field Observation is to assess whether the PRFs are functioning as designed and to identify routine restorative and rehabilitative maintenance requirements. A budget summary of this year's inspection was presented to the TAC and the board of the CCBWQA to provide recommendations for the following fiscal year's budgeting of maintenance activities. The basis and cost estimates for those recommendations are contained in this report.

Restorative and rehabilitative maintenance are the responsibility of the CCBWQA. Routine maintenance is the responsibility of the CCSP. Other items, such as educational/interpretive sign replacement and weed control, as outlined in the Agreement are shared 50/50 by CCSP and CCBWQA. The West Boat Ramp PRF's routine, restorative and rehabilitative maintenance responsibility is 100% the responsibility of the CCSP and/or the Marina.

As defined in the Agreement, the term "Restorative and Rehabilitative Maintenance"shall mean all maintenance and repair reasonably necessary to keep the structural and other essential components or portions of a PRF in good working order and functioning as designed, including but not limited to the repair of walls, embankments, pipes, gates, monitoring facilities, erosion and riprap, the removal of sediment, and the replacement of vegetation within the disturbed area of a PRF as needed to maintain or restore the PRFs function."Routine Maintenance" shall mean any and all maintenance that is necessary (other than Restorative

and Rehabilitative Maintenance) to keep a PRF in a clean, visually appealing and safe condition, free from debris and rubbish, and protected from vandalism and malicious mischief to the same extent as any other public facility located within the CCSP.

The PRFs that are part of the Stream and Drainage System are observed at least annually and after storm events since they are more likely to have changes in their condition. The PRFs that are classified as Shoreline Stabilization are normally observed on an as needed basis, or when the CCBWQA, CCSP and or United States Army Corps of Engineers personnel identify issues or concerns during the year that require an inspection. This year, the Shoreline Stabilization PRFs were inspected for maintenance and repair needs as a followup to the unusual flooding that occurred in May and June of 2023 and the unusually long high-water retention throughout 2023 and early 2024.

The purpose of the inspections of all the PRFs is to:

- Observe their functionality as a PRF.
- Determine if they are operating as designed.
- Determine if they are operating safely and efficiently.
- Establish restoration and rehabilitation needs.
- Calculate the costs of restoration, rehabilitation and maintenance.

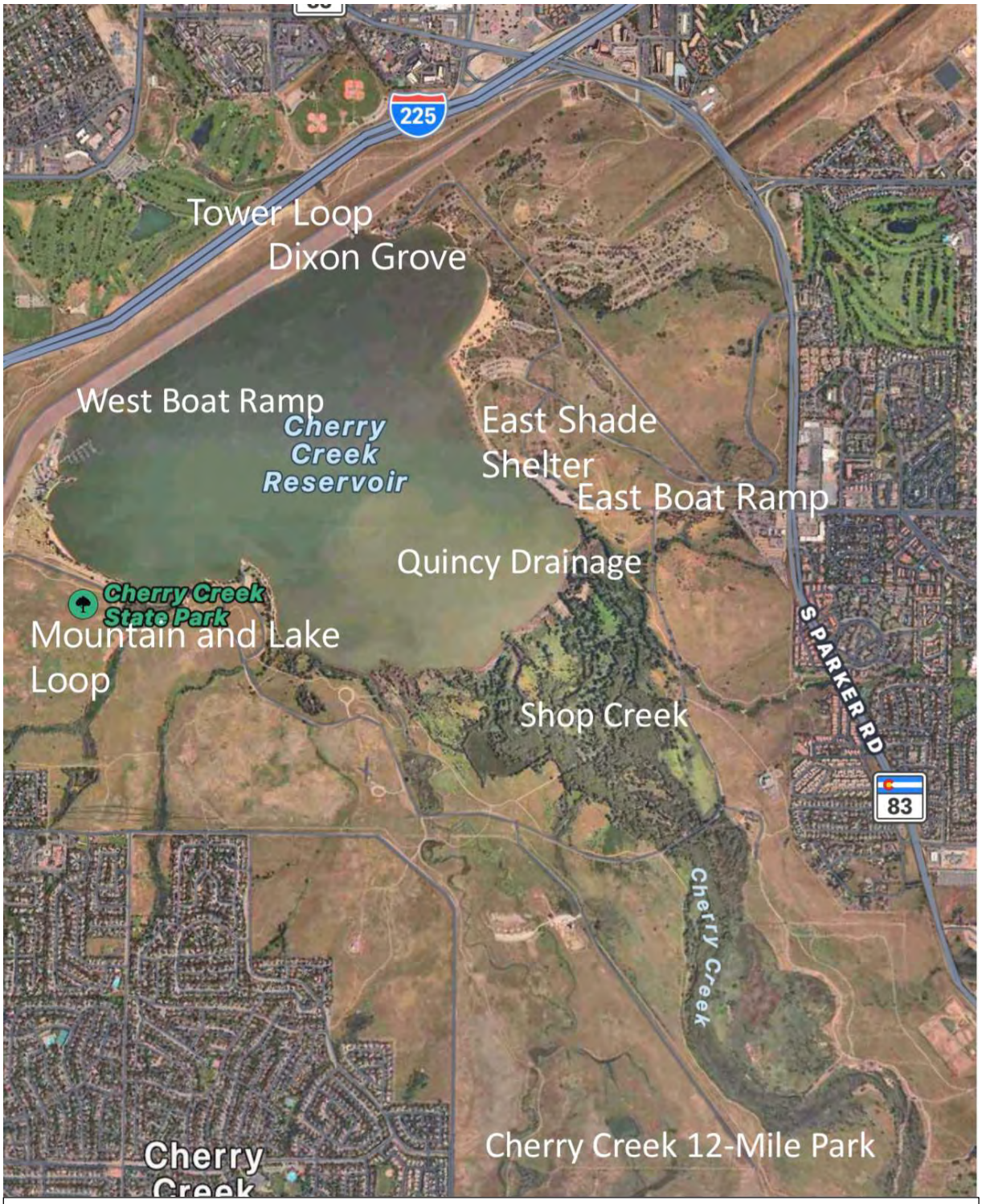
The aerial photograph shown on the following page shows the general vicinity of the In-Park PRFs.

The following facilities are included in the In-Park PRFs:

Stream and Drainage System
Shop Creek
Cherry Creek 12 mile Park (All Phases)
Cottonwood Wetlands
Cottonwood Stream Reclamation
Quincy Drainage
West Boat Ramp
Peoria Ponds (new this year)

Shoreline Stabilization
Tower Loop
Dixon Grove
East Shade Shelters
East Boat Ramp
Mountain and Lake Loop

All the PRFs were observed, both Stream and Drainage and Shoreline Stabilization PRFs. The field observations were conducted earlier than in 2023 in order to get a head start on the budgeting process, and were conducted on August 12, 13, 15, 23, and 27. Parks officials did not accompany the inspections as they were too busy and requested a walkthrough later in the year.

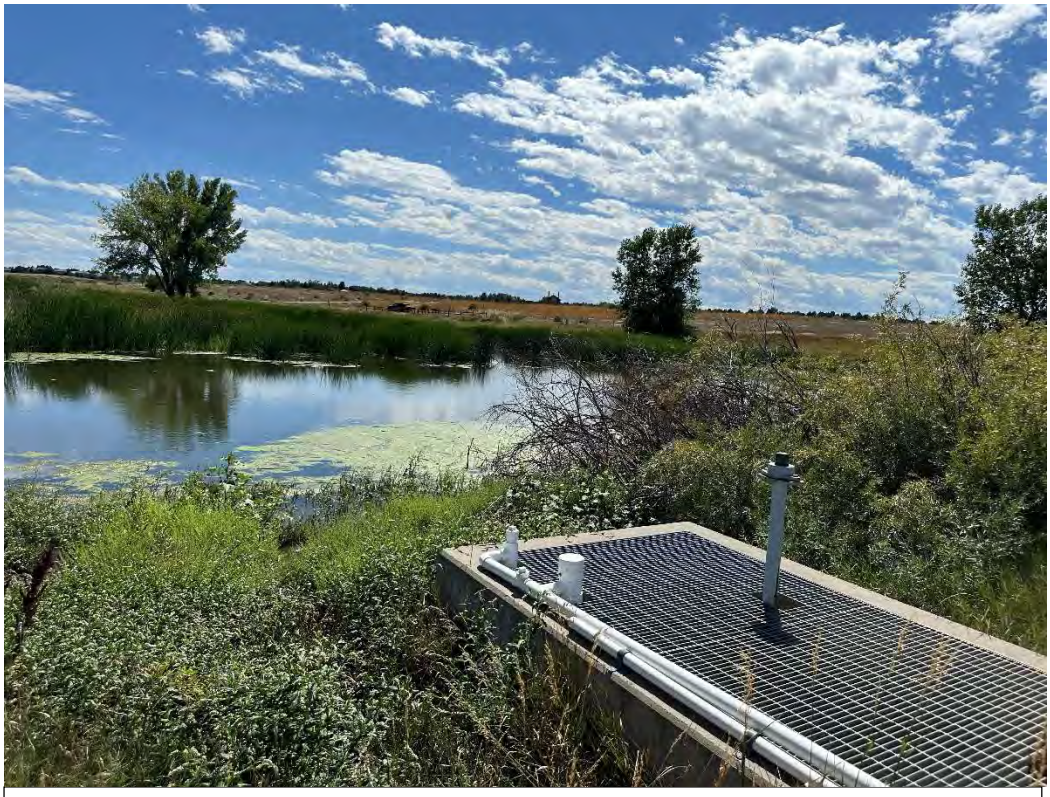


In-Park PRF Locations

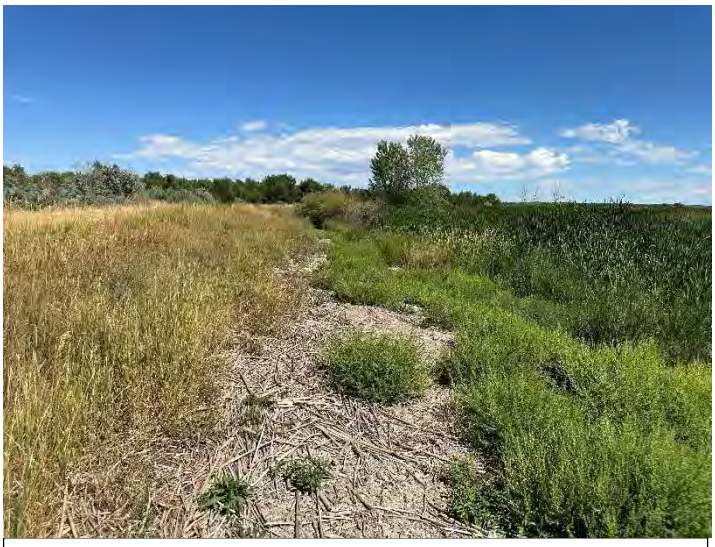
Inspection Observations and Assessments

The general assessments for the Annual Field Observation and photos are provided on the following pages.

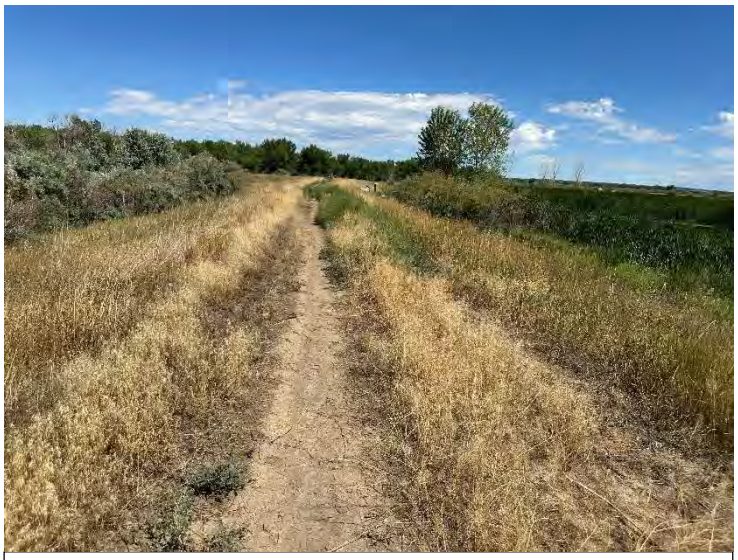
Cottonwood Wetlands: Aquatic vegetation and cattail debris was observed on the surface of the water. The water level was up significantly at the time of the inspections, principally due to the outlet structure being clogged, and high enough that water was overflowing the access trail. The educational signs were in good shape. Some plant stress was observed from last year's floods and dead areas observed where the higher than normal water surface remained too long. Maintenance recommendation is re-vegetation of the dead areas with some weed control and cleaning out of the outlet structure grate twice in 2025 to maintain normal pond operating levels.



Outlet structure with excessively high water level and clogging of the outlet grates

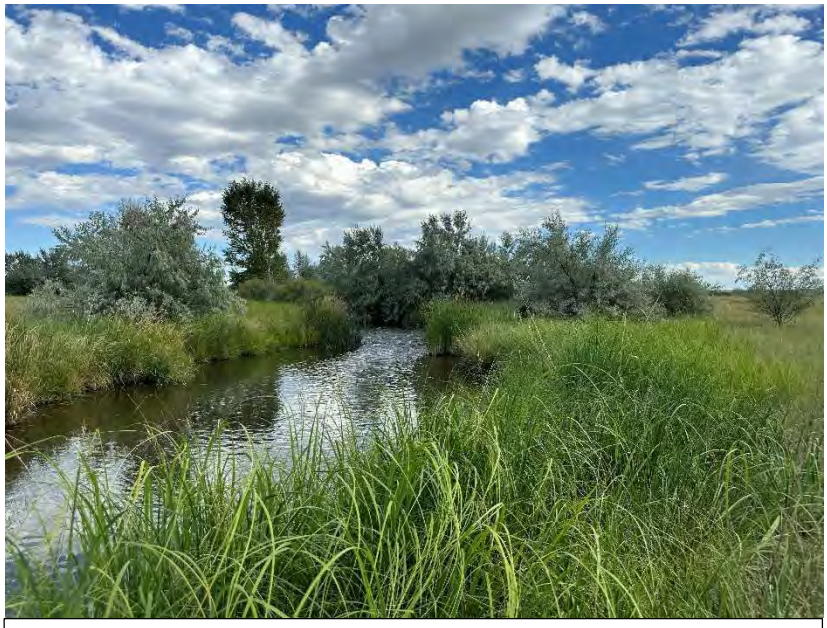


Weeds growing in dead areas created by excessively high water levels

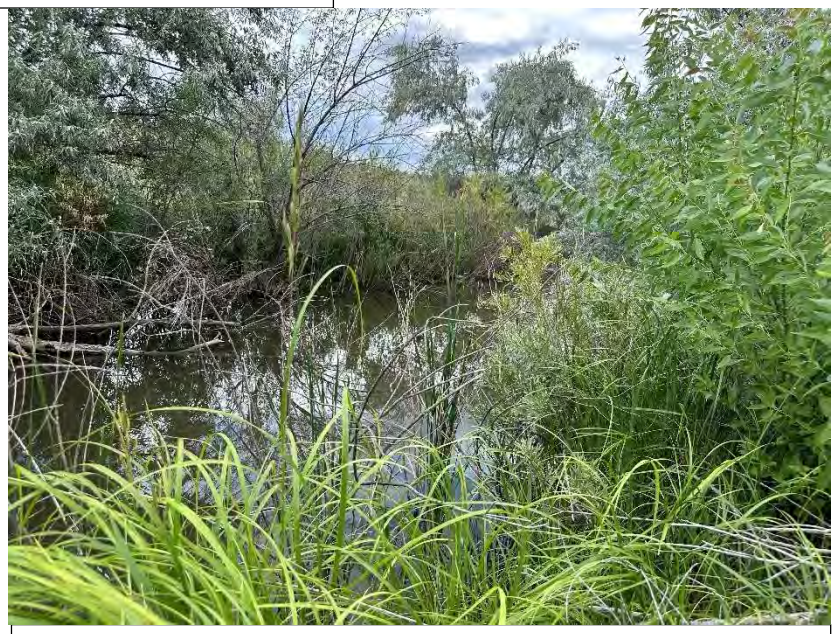


Wheel-tracking from last year's harvesting activities regrown well except for social trail

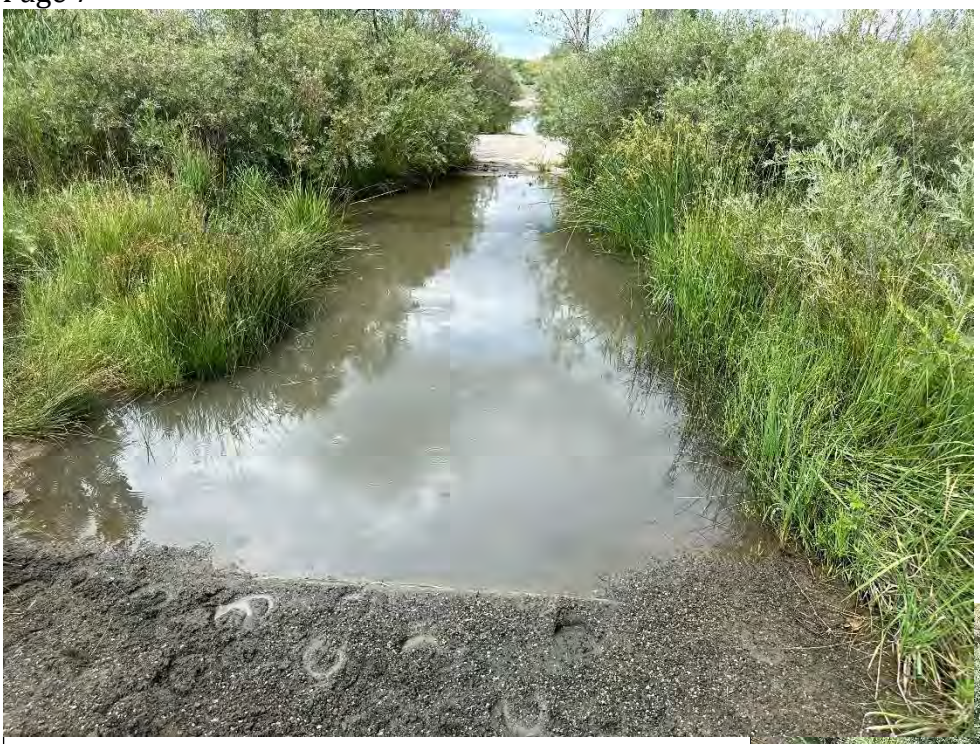
Cottonwood Creek Stream Reclamation: This PRF is highly functional, with the vegetation striving all the way to the water's edge, and the riffle drops and crossing structures operating well. Evidence of high-water debris from the 2023 storms was still present in the over-bank areas, and the design velocities of the storm flows were shown to have been adequately projected to prevent erosion of the over-bank areas and all the over-bank vegetation weathered the 2023 storm flows extremely well. Some noxious weeds in the form of Russian Olives and Common Reed were observed. Excess vegetative debris was observed to be creating significant clogging and damming of the stream's progress, similar to the beaver dams that were observed last year. This was especially evident in the upper parts of the stream system, particularly upstream of the confluence of Cottonwood Creek with Lone Tree Creek. The worst result of this was evident with the flooding of the trail and most southern stream crossing. Evidence of this year's harvesting activities was noted with some wheel-tracking compaction evident. No maintenance activities were specifically identified, however, monitoring and coordination with CCSP staff regarding noxious weeds is recommended. Finally, some trail erosion was noted and CCSP will need to continue its trail maintenance.



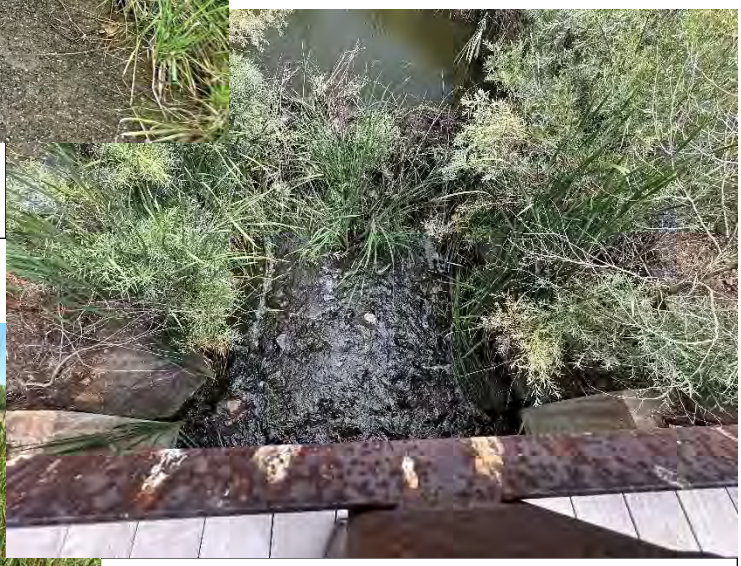
Thriving vegetation



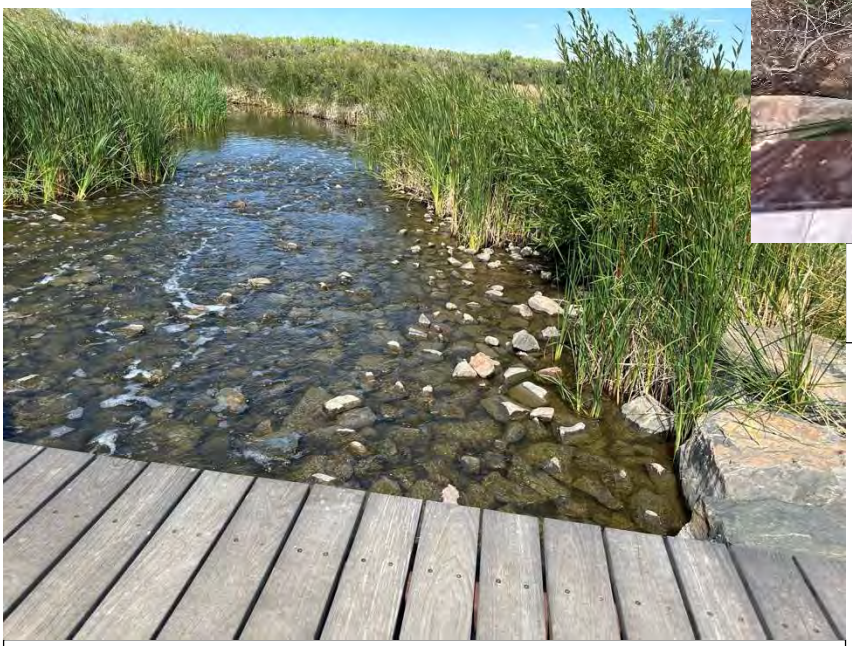
Thriving vegetation



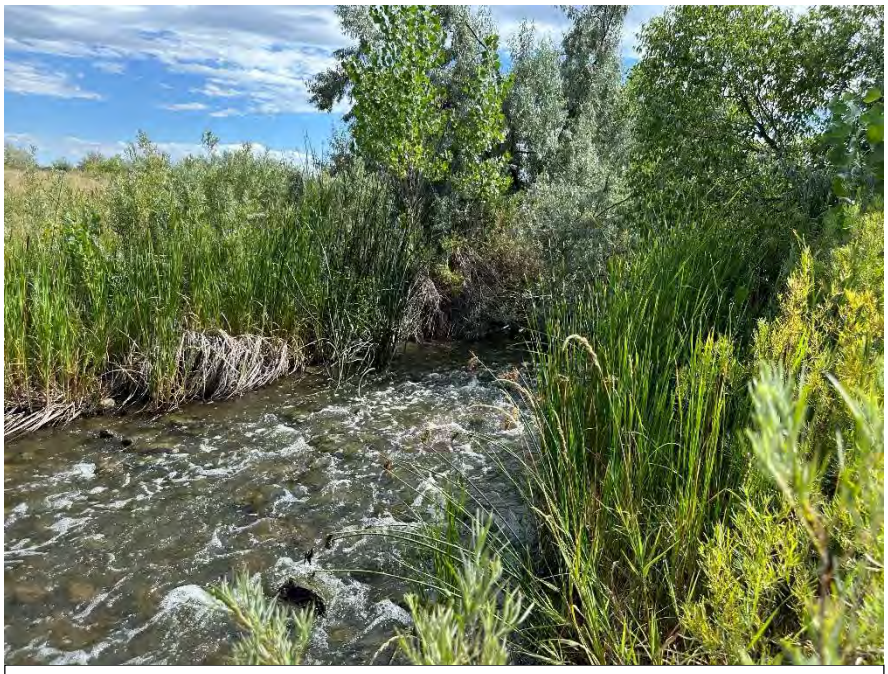
Stream back-up at southern-most stream crossing



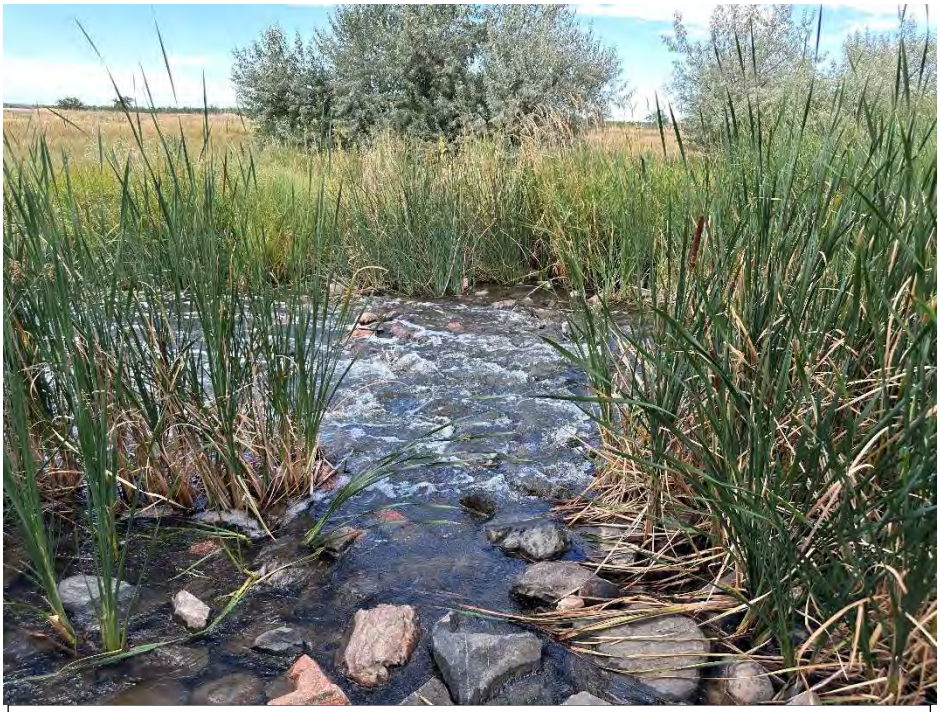
Vegetative debris blocking stream channel



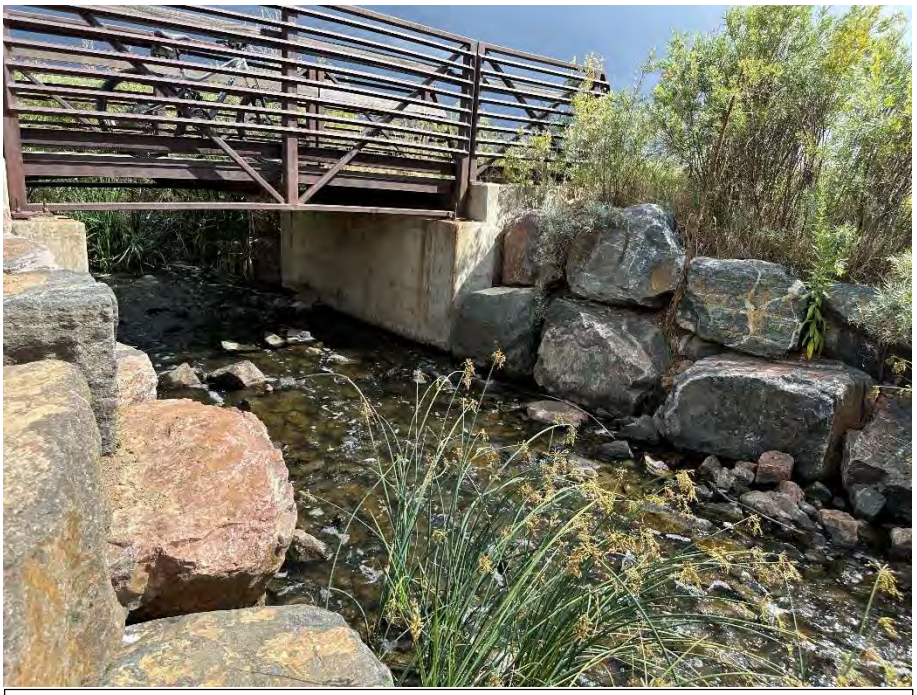
Riffle structure at lowest trail crossing in excellent condition



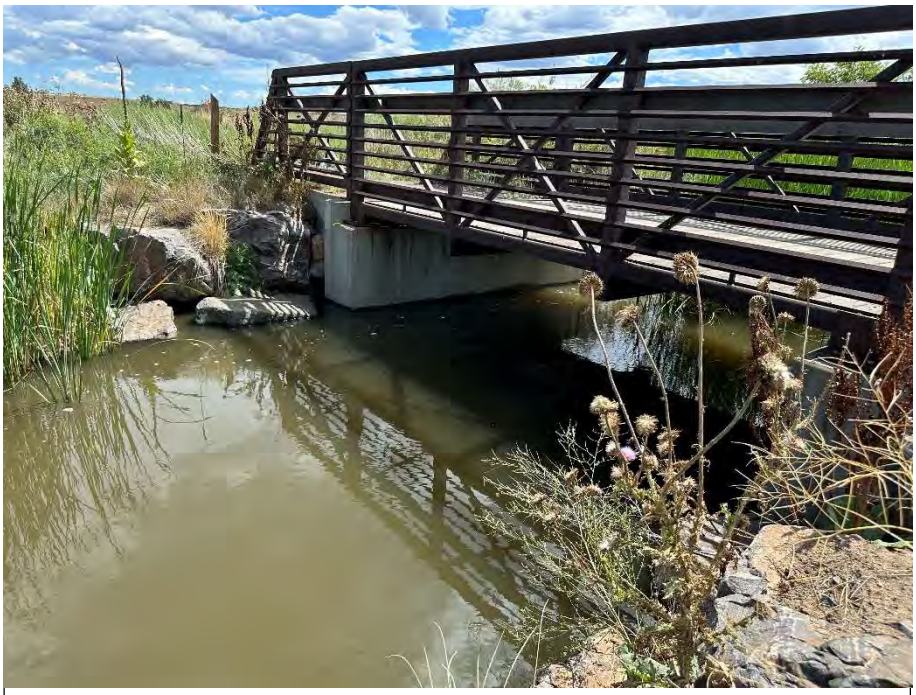
Riffle structure near old Cottonwood alignment and shooting center



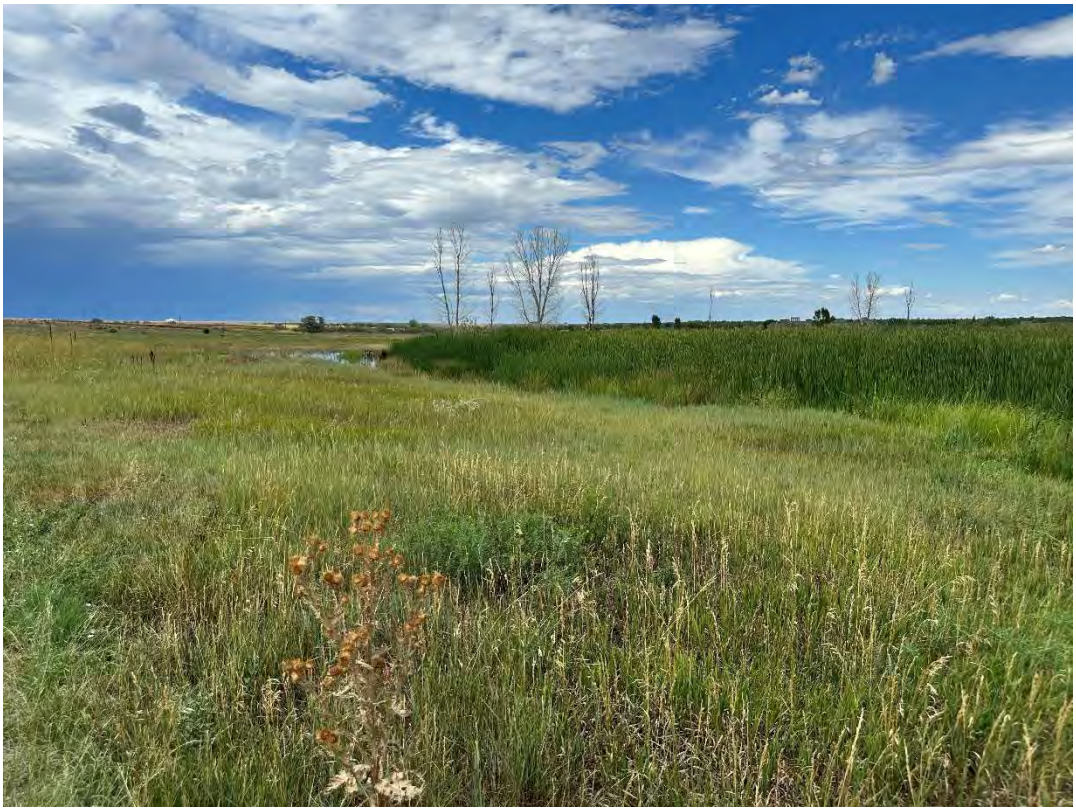
Riffle structure downstream of confluence with Lone Tree Creek



Crossing east of S Cherry Creek Drive and Peoria St. in excellent condition



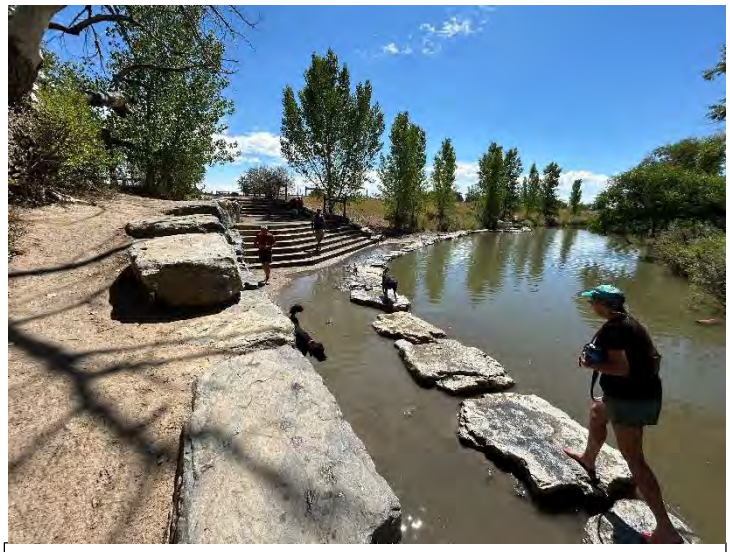
Stream back-up near middle crossing created by debris clogging



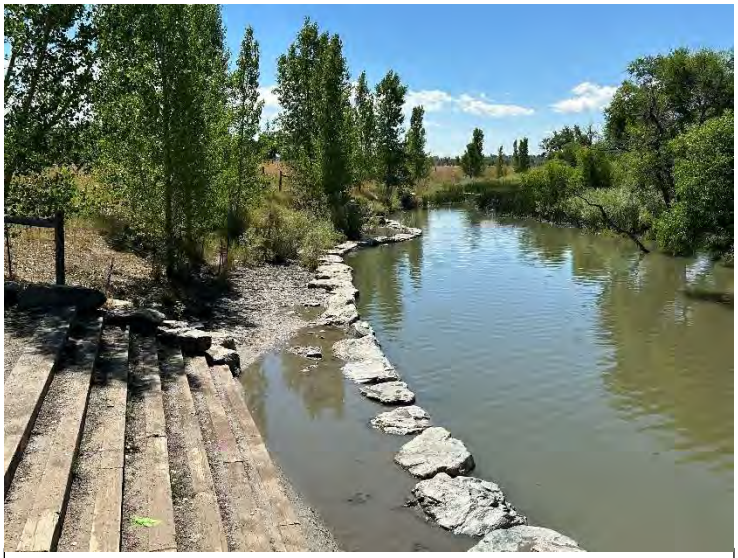
No plant stress and no evidence of erosion from last year's storms typical in the over-bank areas. Very healthy growth is abundant

Cherry Creek 12-mile Park-All Phases:

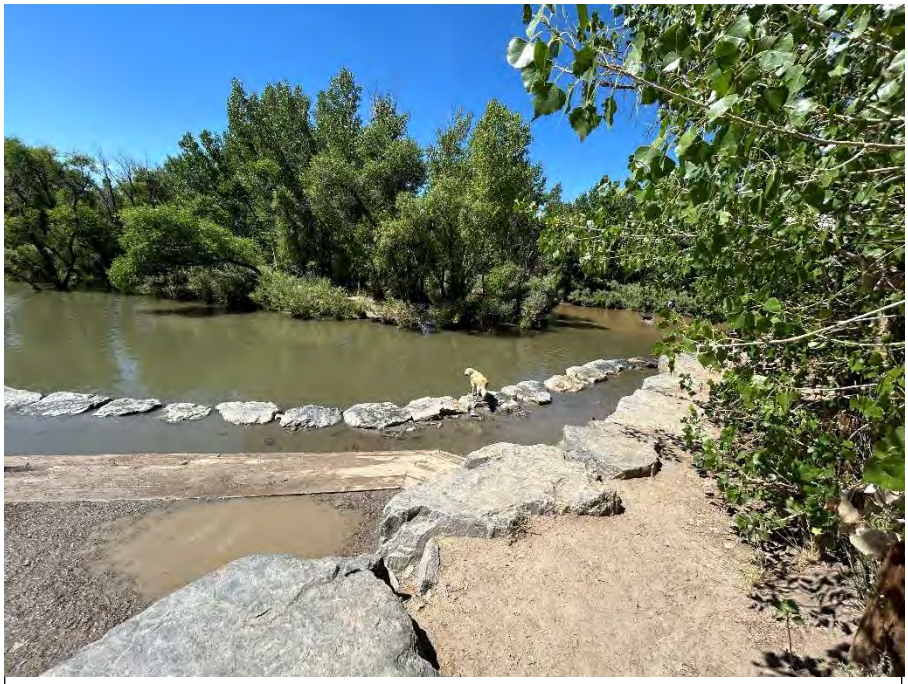
All three phases of the project were inspected from upstream to downstream, beginning at the first access point. Overall, no additional damage other than what occurred in the storms in May and June of 2023 was observed. The keys damage issues remain essentially the same as in 2023. Backfill in some of the erosion areas at the base of the access stairs would classify as needing maintenance attention, for pedestrian safety, the height from the bottom timber step to the ground surface being greater than the height from timber step to timber step. The water levels were higher in the area of the 4th access point, flooding the eroded areas behind the boulder edging. This higher water is thought to be caused partially by the logjam downstream that was created by the 2023 floods. As this logjam appears to be acting like a natural grade control structure, we are recommending that it be reinforced to allow it to continue to act as a grade control structure in the future. The erosion behind the boulder edging where the concrete trail abuts the boulder edging is severe enough that the trail undercut areas should grouted to protect the trail. The rest of the damage will need to be rectified in near-future stabilization projects. The displacement of the "breakout" area is, perhaps, the most significant area needing stabilization attention, as well as the lost boulder edging downstream of Access Number 4. The entire area upstream of the grade control structure has suffered extreme bed erosion to such an extent that tree islands 2-3 feet high have been created. It also appears that the main channel has deviated from previous years. Of additional concern is whether stabilization of the east bank of Cherry Creek with the boulder edging is actually creating an off-set destabilization of the stream bottom and even of the west bank. All of this indicates that a serious re-evaluation of the original design concepts should be done to determine their functionality and applicability to stabilizing or reclaiming a stream that is constantly changing its course and if some alterations of prior designs should be effected to



Behind-the-boulder edging erosion at the fourth access point



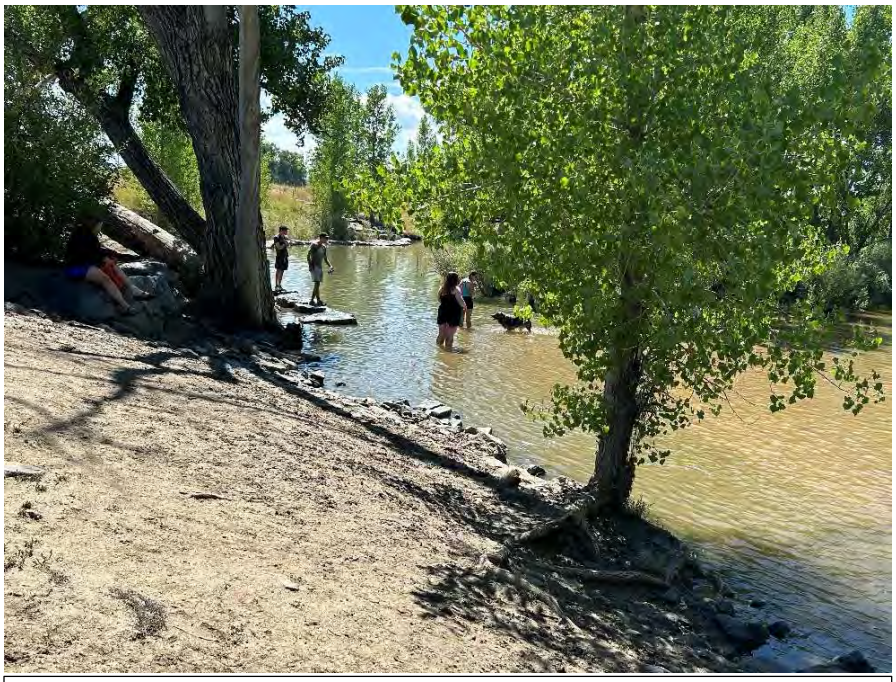
Behind the boulder edging erosion at the base of the stairs of the third access point-repair project for 2025



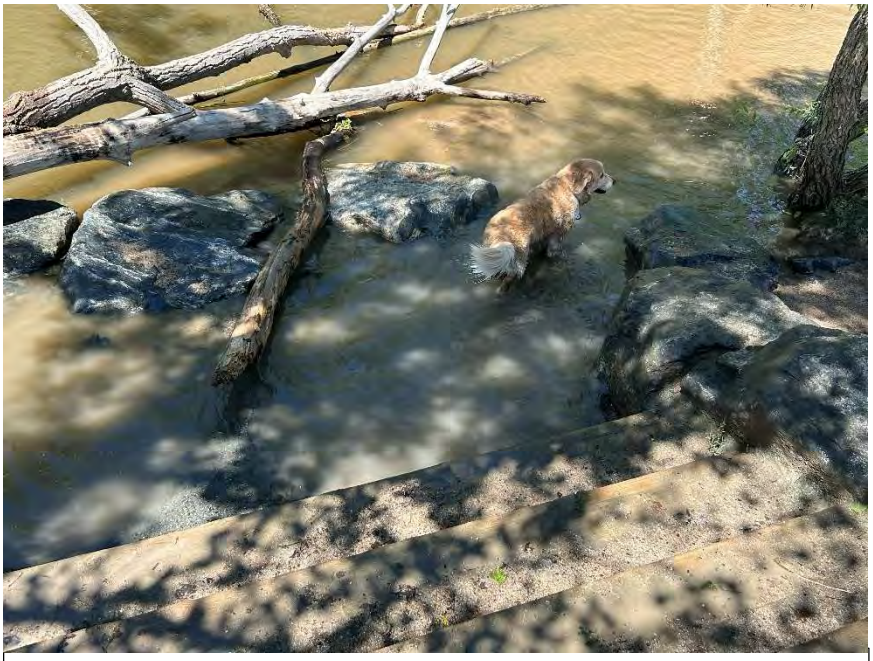
Behind-the-boulder edging erosion at the Fourth Access Point

repair the damaged areas rather than simply repairing the damaged areas back to the way they were originally designed.

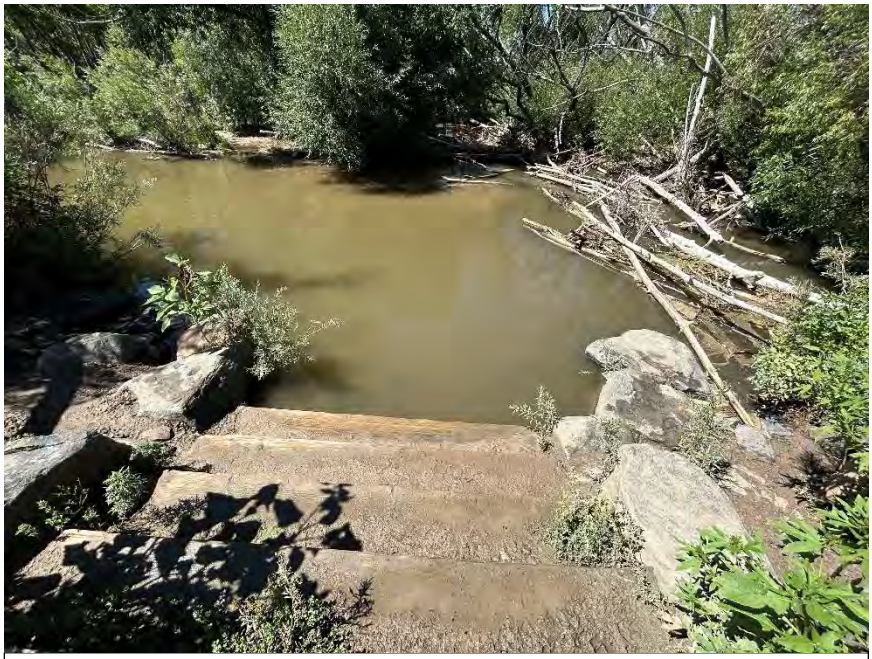
An additional inspection was made on August 27, 2024 with Elysa Loewen and Andrew Earles to verify the extent of the stream's behaving differently than was originally contemplated and designed. A copy of the report of this additional inspection can be found in Appendix B of this report. The result of the inspection was a substantiation that further analysis was necessary before major costly repairs were made. It was agreed that revegetation of the Phase III improvements should be considered a flood repair item rather than a warranty repair item for the Phase III project contractor to accomplish. Maintenance projects include revegetation of the Phase III construction area, relocation of the riprap at the grade control structure, bolstering of the logjam to act as a grade control structure, backfill behind the boulders at Access 4, and performance of a preliminary forensic analysis of the entire 12-Mile project.



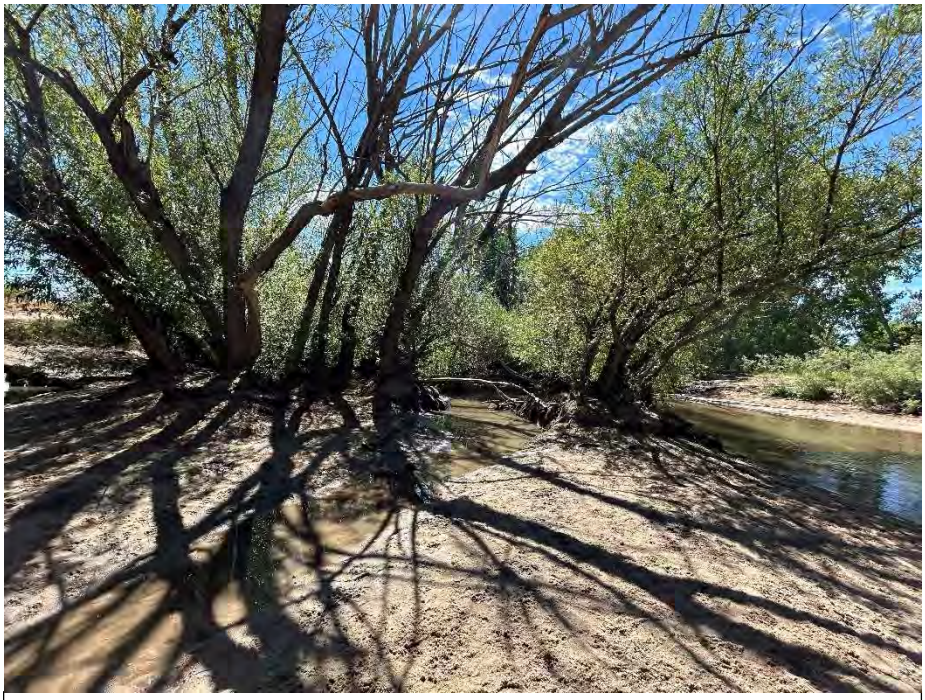
Boulder edging erosion just below Fourth Access Point



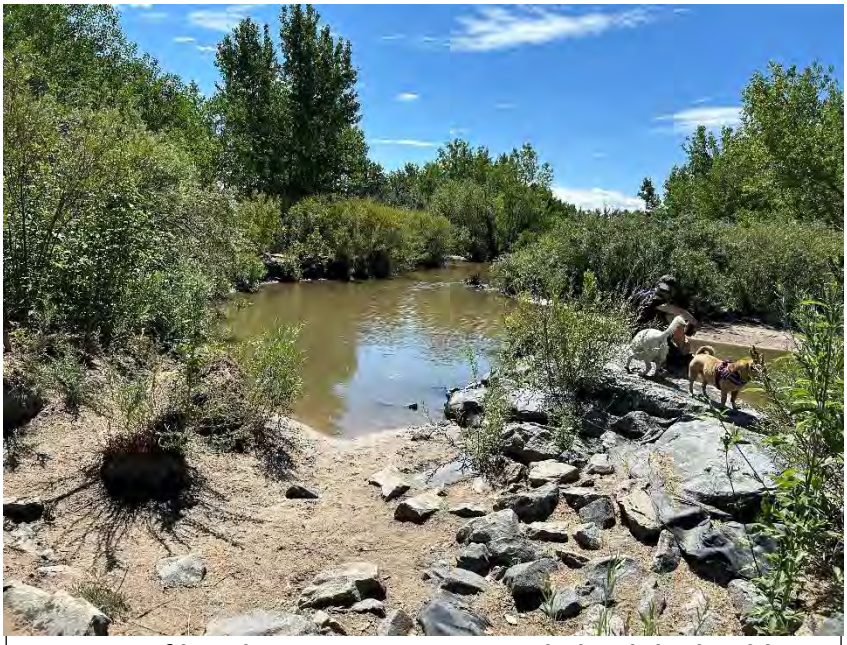
Boulder edging erosion below Access 4. Also sediment deposition almost to the level of the original boulders.



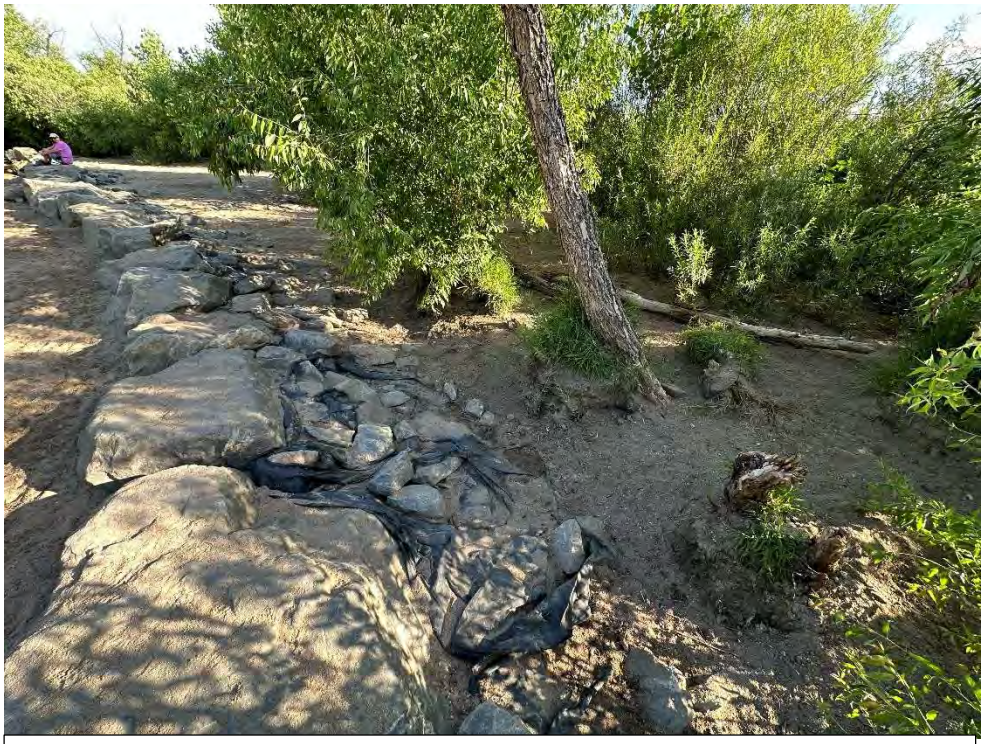
One more edge-boulder missing from last year at bottom of steps. Logjam is acting as a natural grade control structure



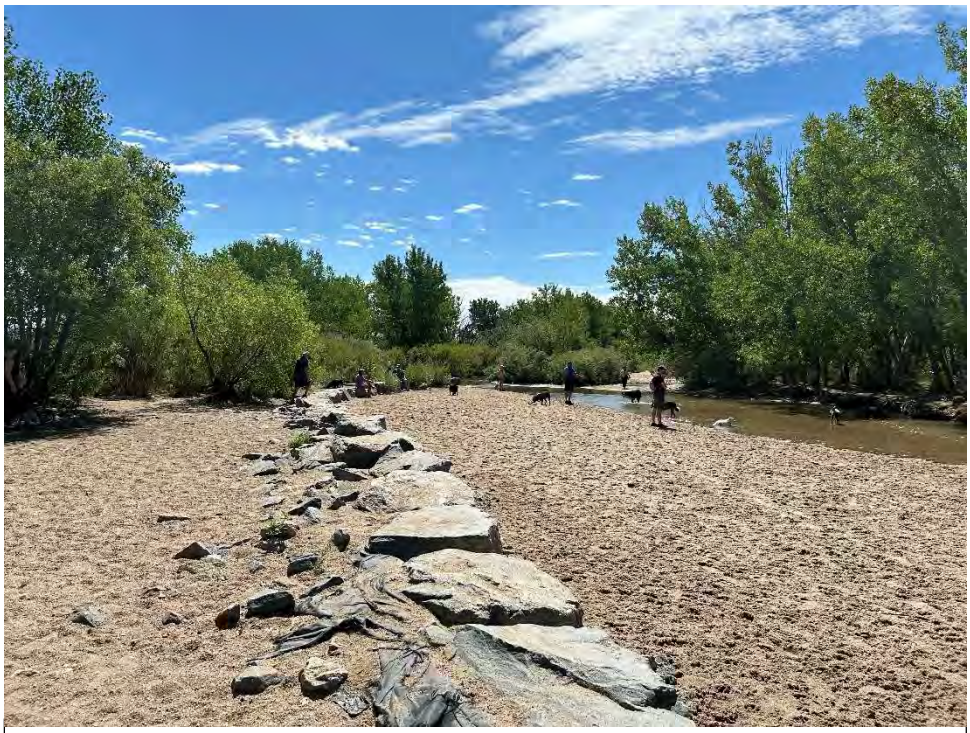
Tree islands caused by extreme bed scour



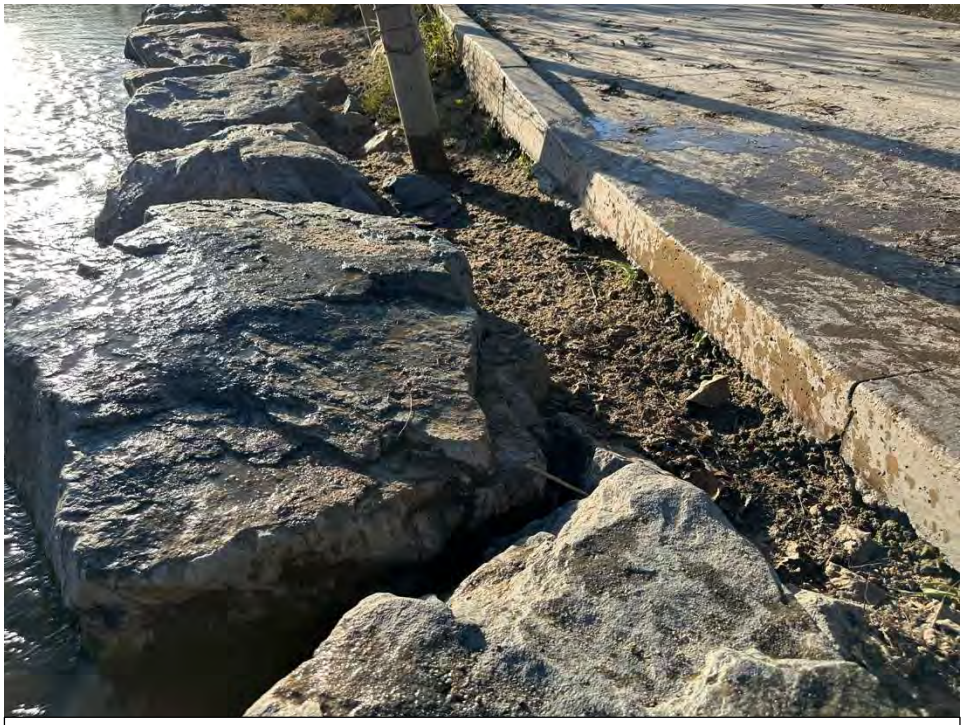
Beginning of beach area- severe erosion behind the boulder edging starting a second channel behind the boulder edging



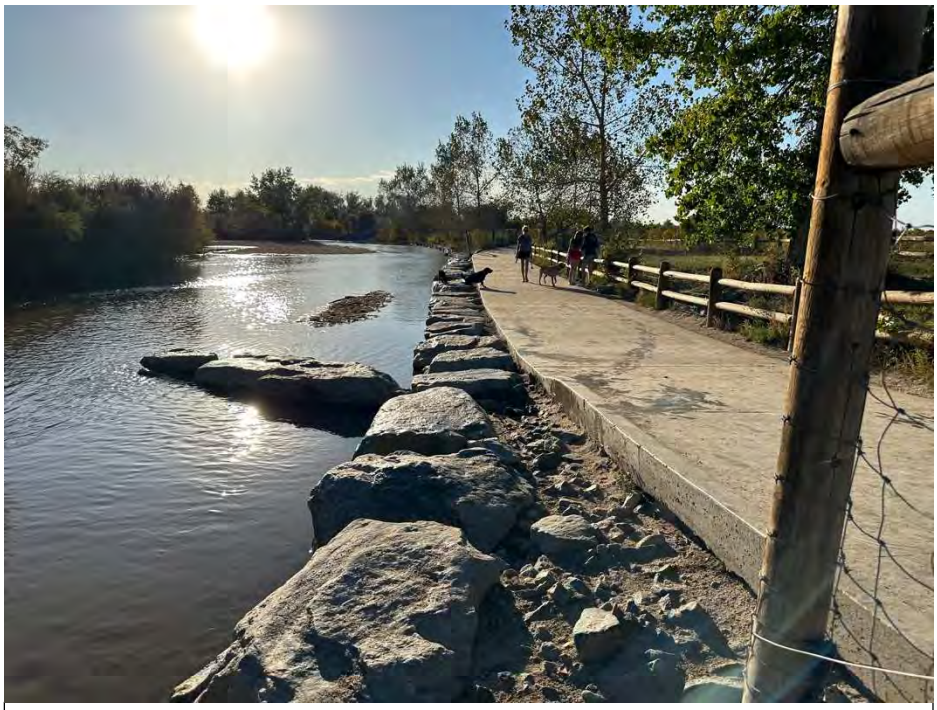
Severe erosion behind boulder edging just before the beach area.



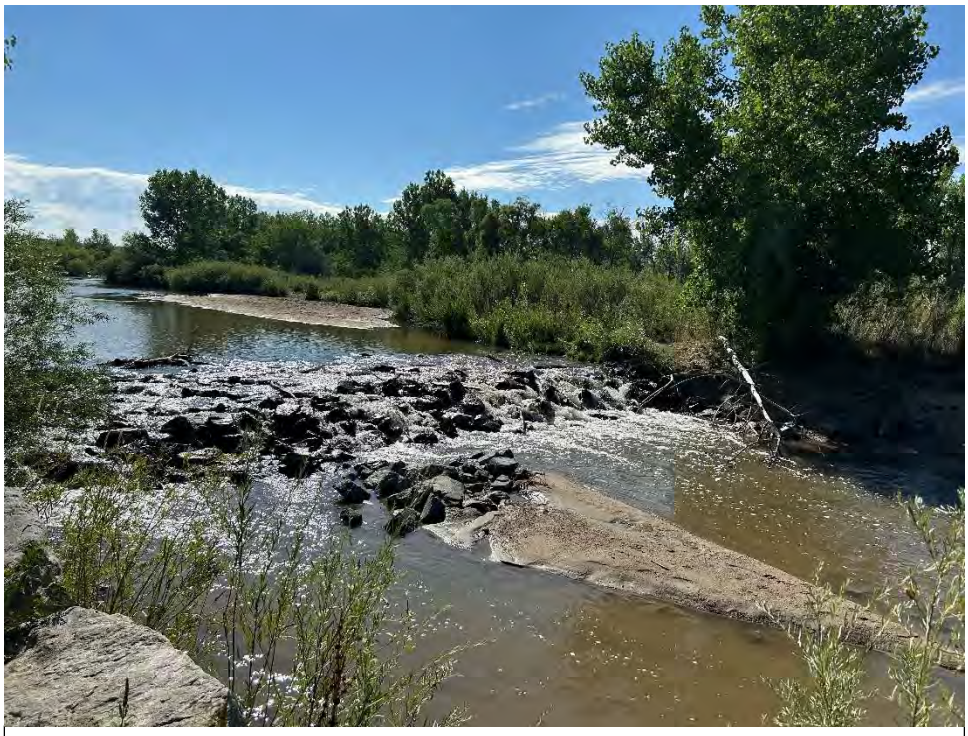
The boulder edging is now a spine, away from the water and the high point of the bank, with beach on both sides, not an "edge" of anything.



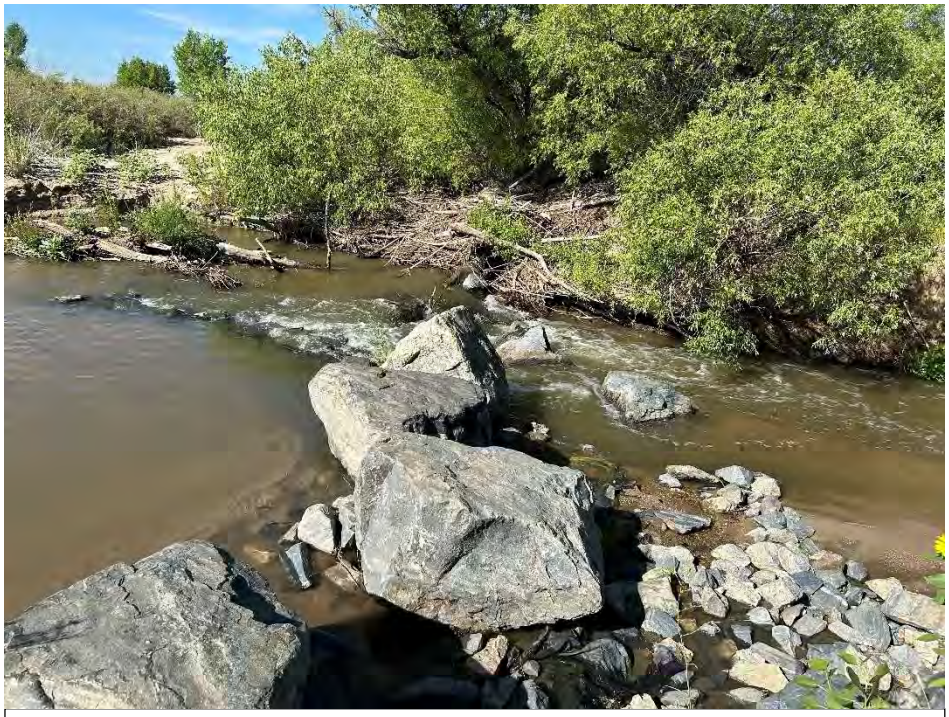
Erosion behind boulders undercutting trail.



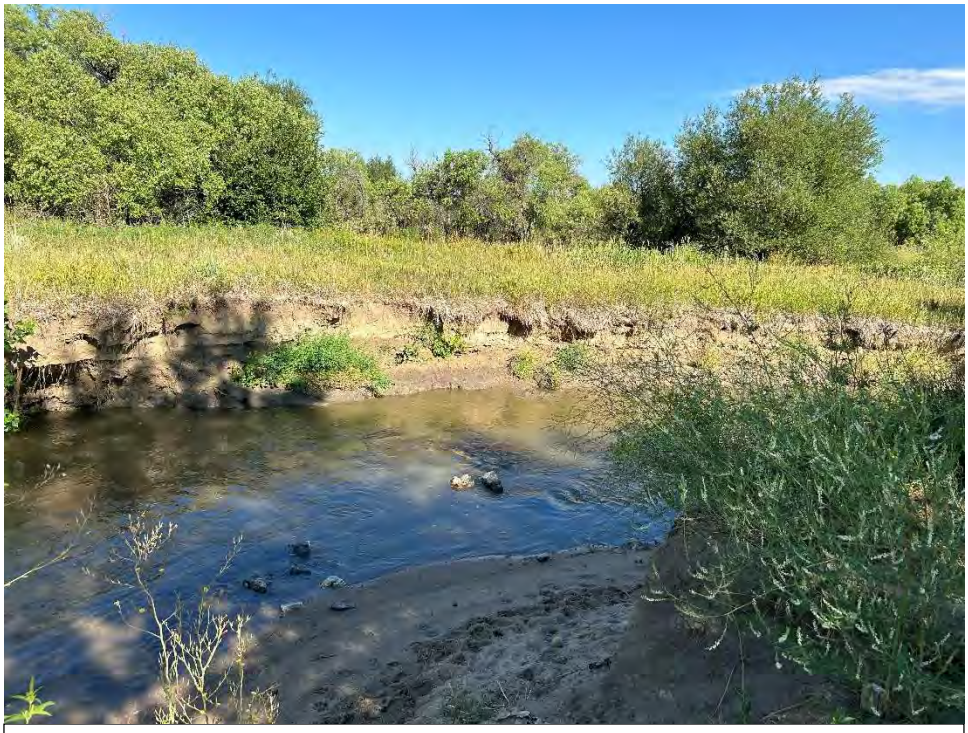
Erosion behind boulders undercutting trail.



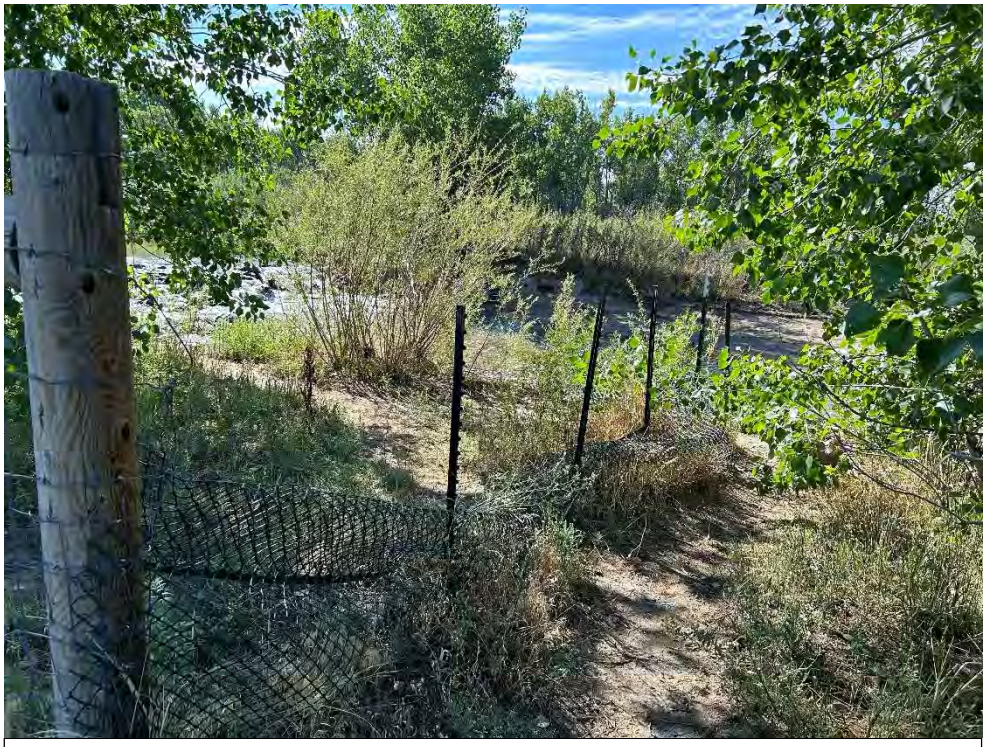
Grade control structure continued to work well-some of the riprap that has washed downstream will be relocated back to the structure as a repair project for next year



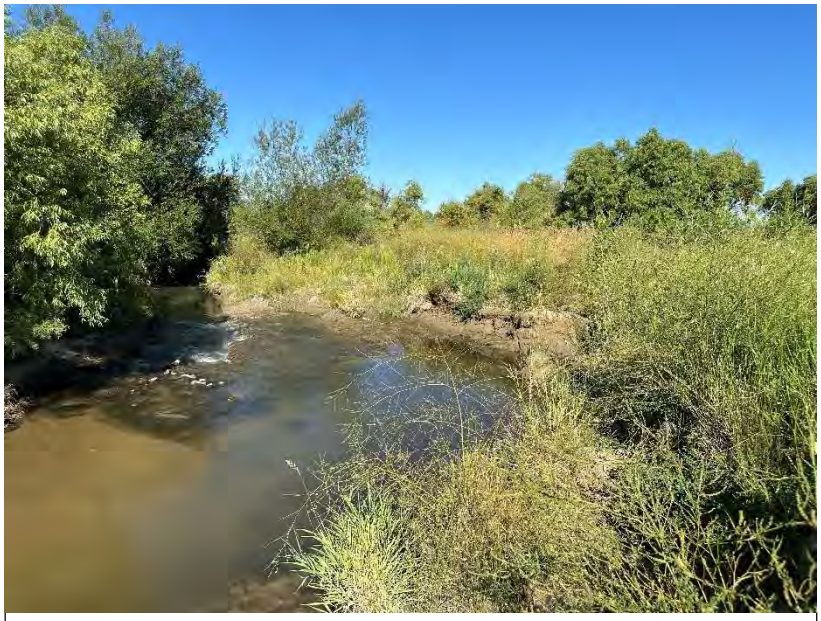
Severe erosion at breakout area



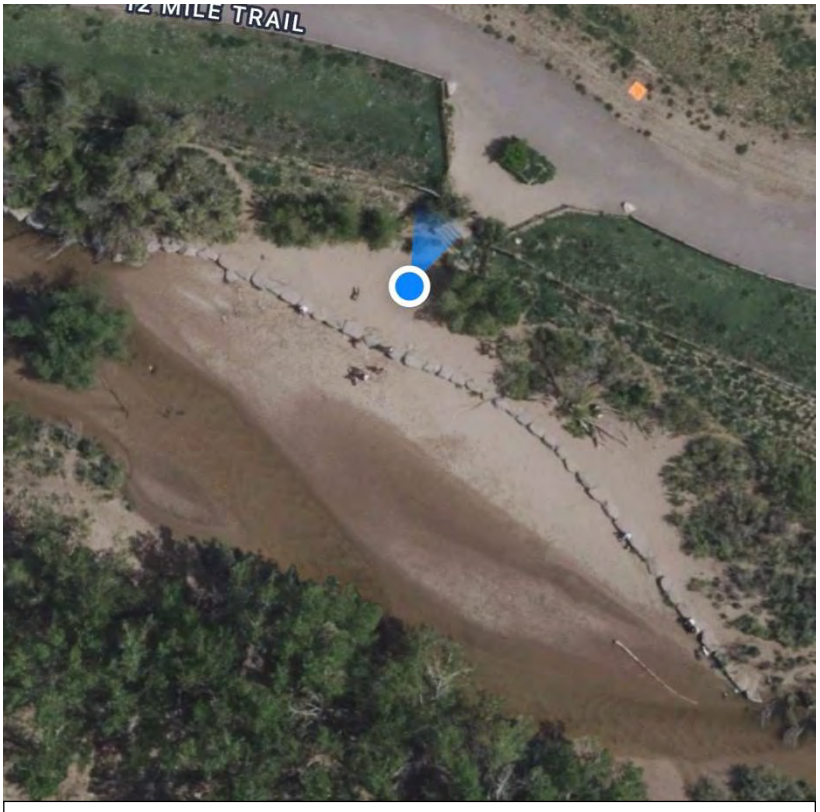
Severe erosion at breakout area-stream is degrading down below claystone level.



Failed revegetation from Phase III project- will be part of repair project for 2025

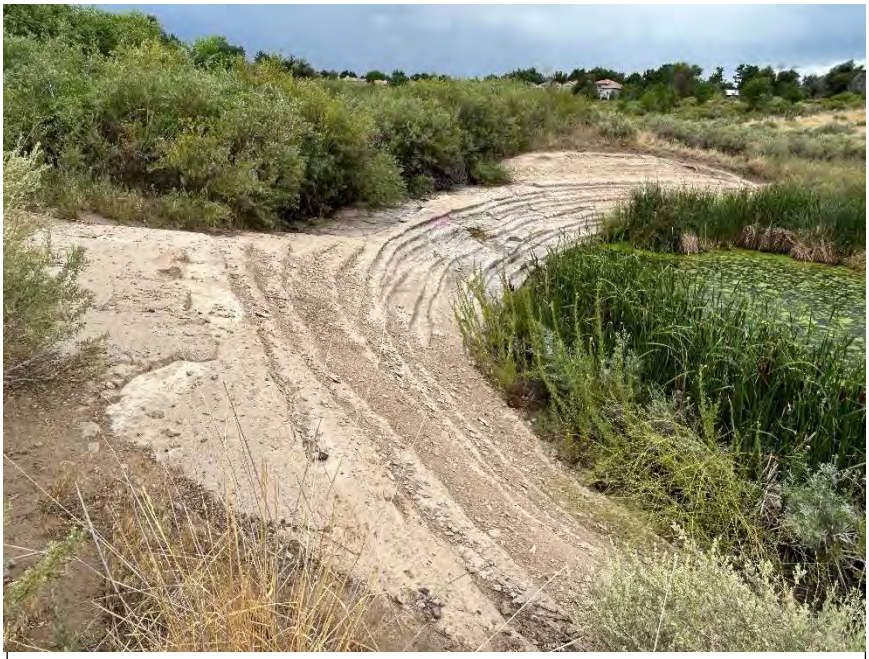


Downstream of the breakout area

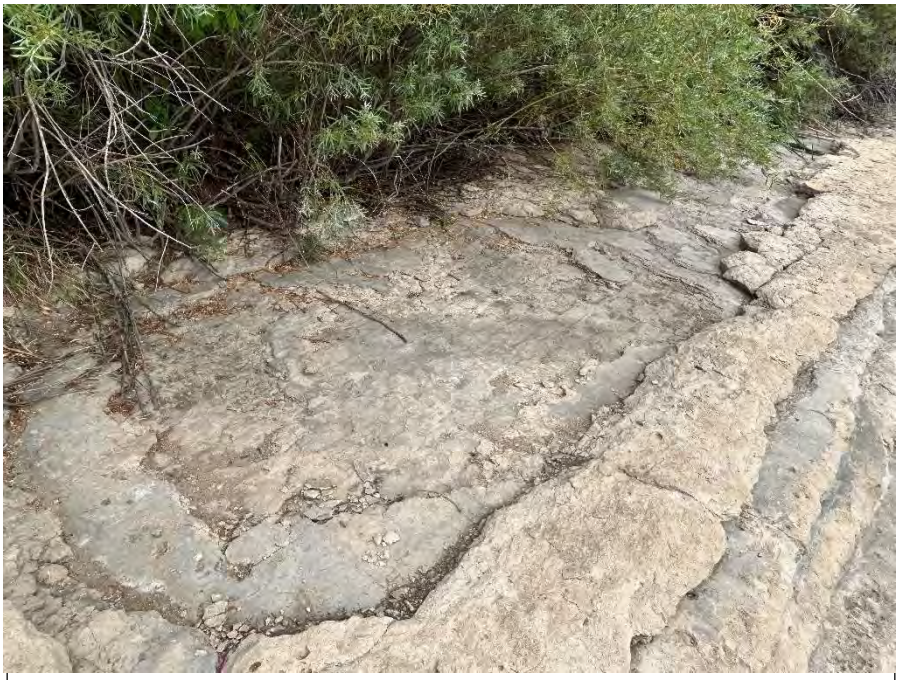


Satellite photo of DOLA beach showing how the creek doesn't follow the path that was used for the boulder edging design.

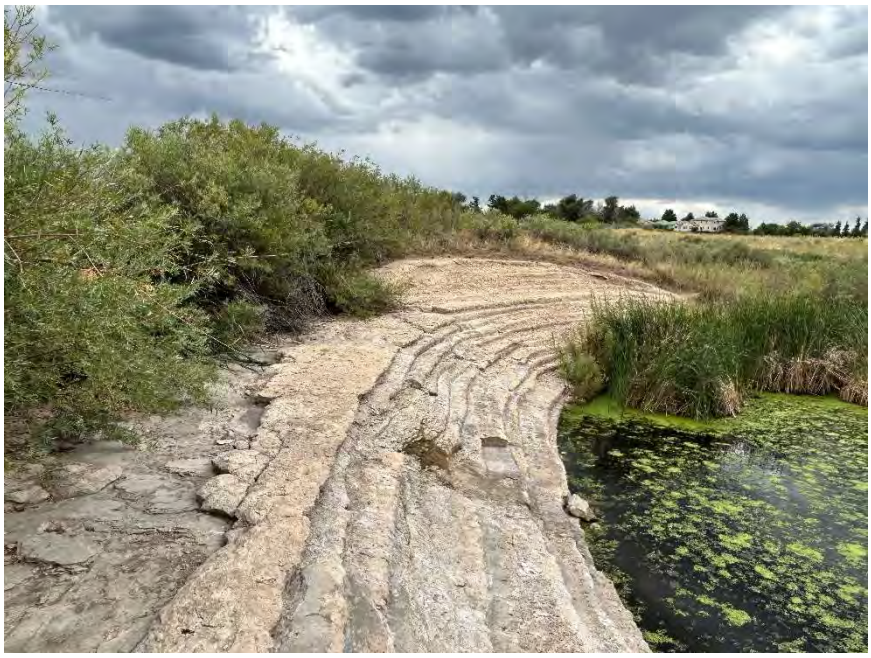
Shop Creek: There are 5 drop structures within CCSP numbered 1 through 5 from upstream to downstream, and an additional drop structure outside of the CCSP Boundary. All of the drops have the same basic problems with spalling concrete along their crests, seepage between layers of roller-compacted concrete on some, vegetation growing on downstream faces, and severe erosion and spalling around their outlet structures. The recent floods did not appear to have created any of the damage, most of it being created through general wear and tear. Repair of the concrete around the outlet structures, herbicide application, and one tree removal was budgeted for maintenance and repair in 2024 from the 2023 inspection, but wasn't completed at the time of the inspection. At the time of finalizing this report, those repair items have been completed. The information signs were in good repair and not in any need of attention.



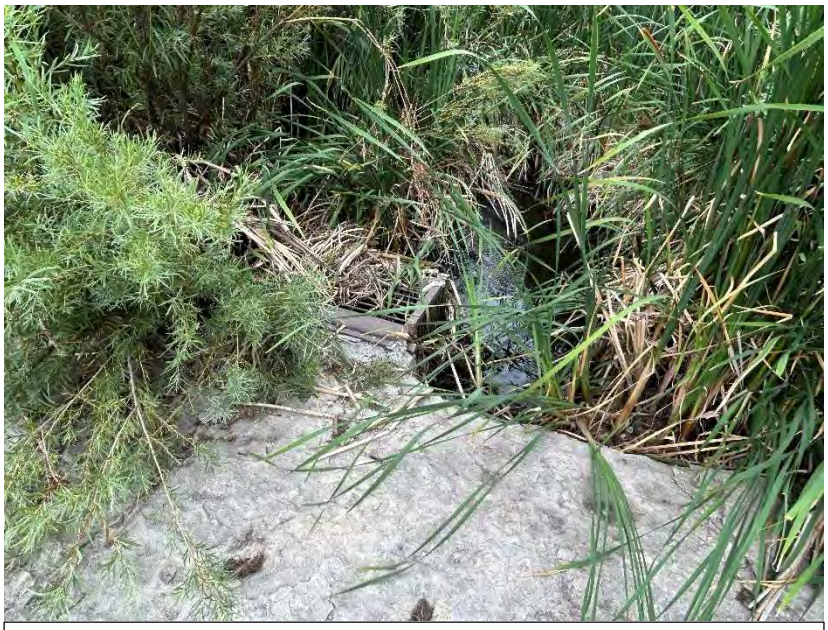
Drop No.1



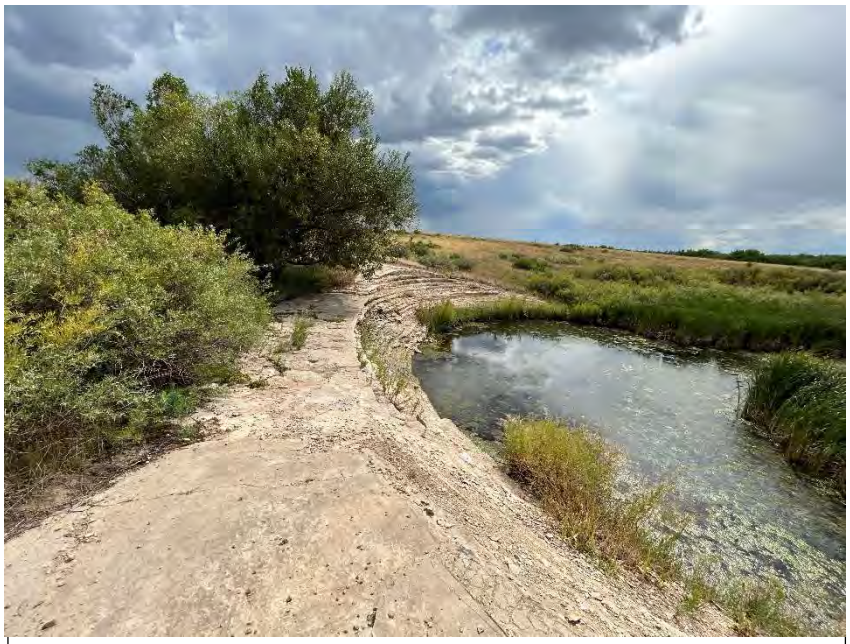
Drop No. 1 outlet structure overtopped and clogged with weeds



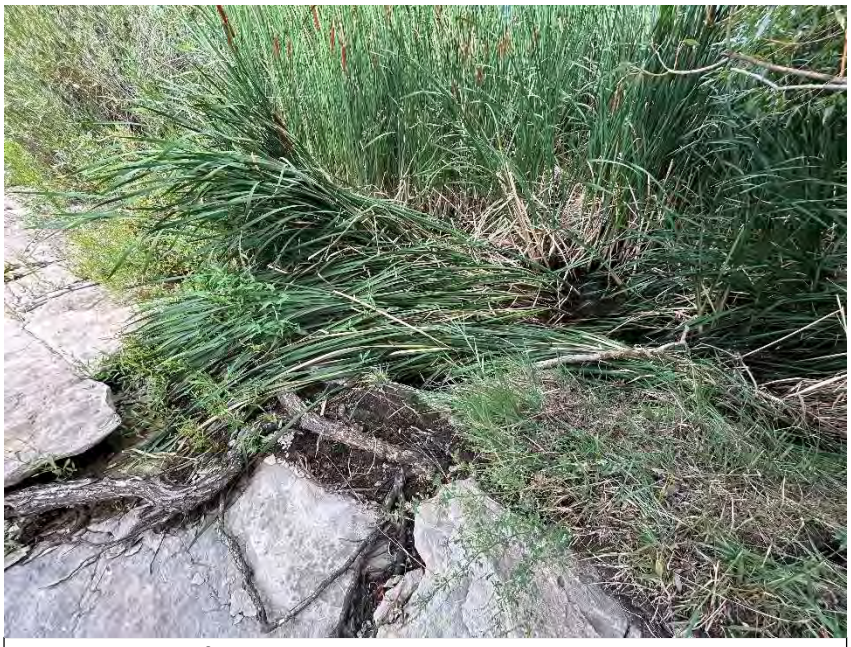
Drop No. 2



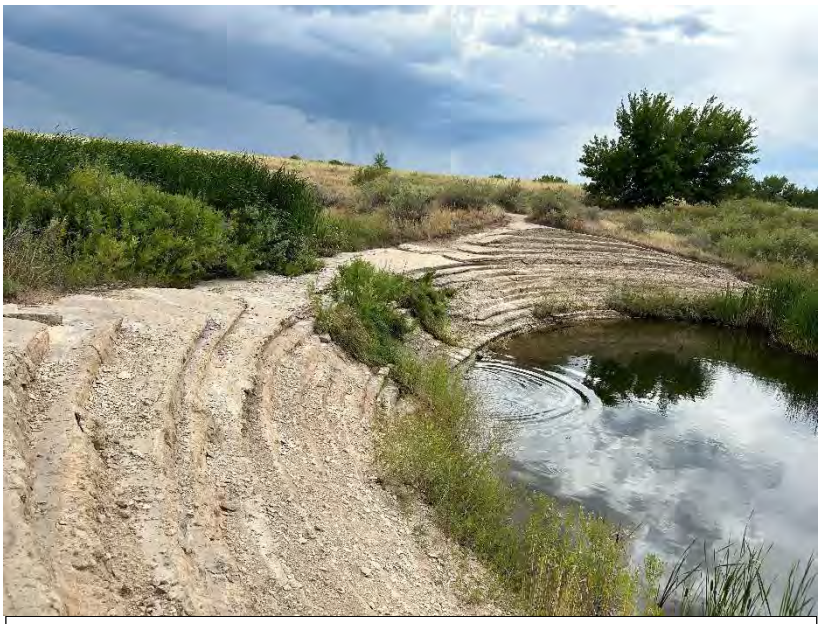
Drop No. 2 Outlet



Drop No. 3

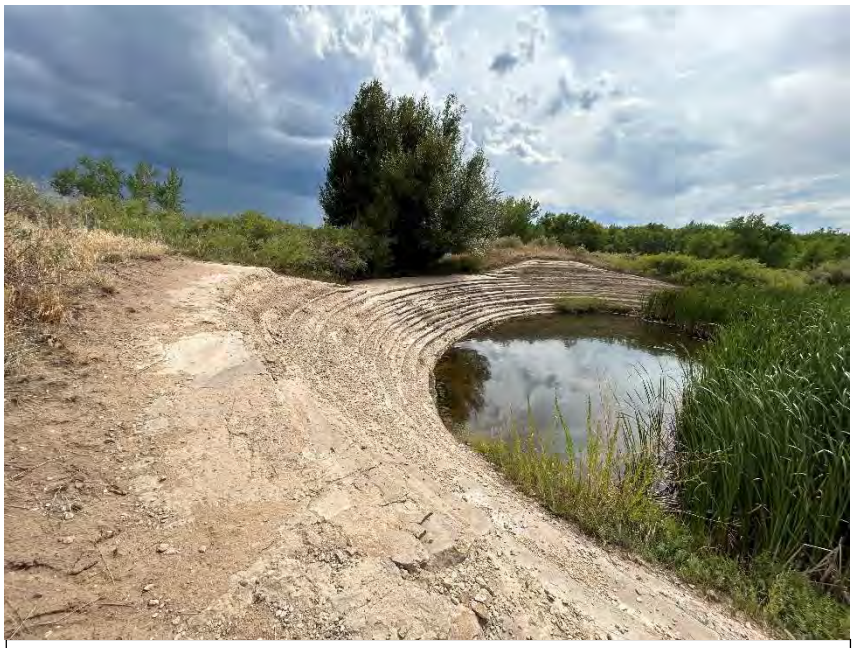


Drop No. 3 Outlet

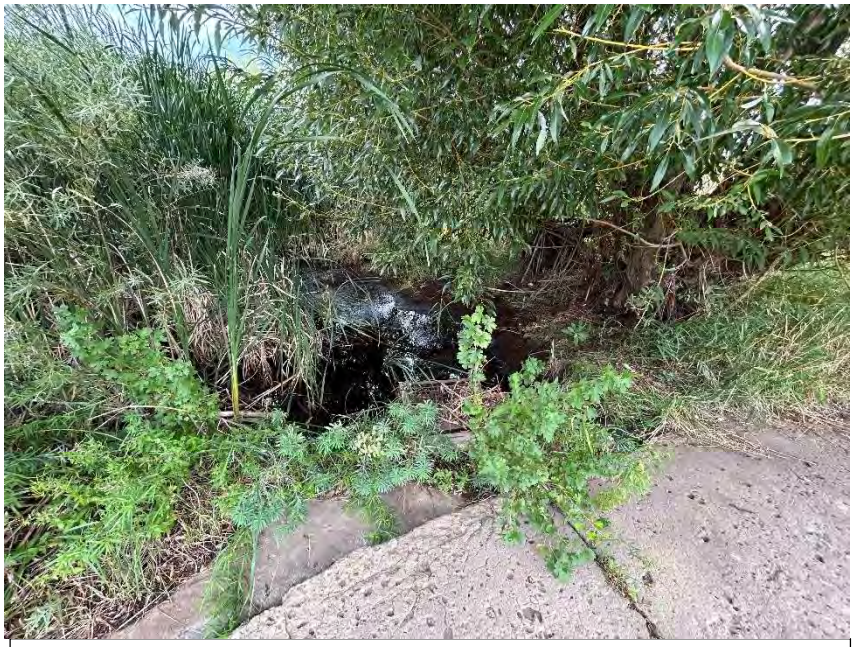


Drop No. 4

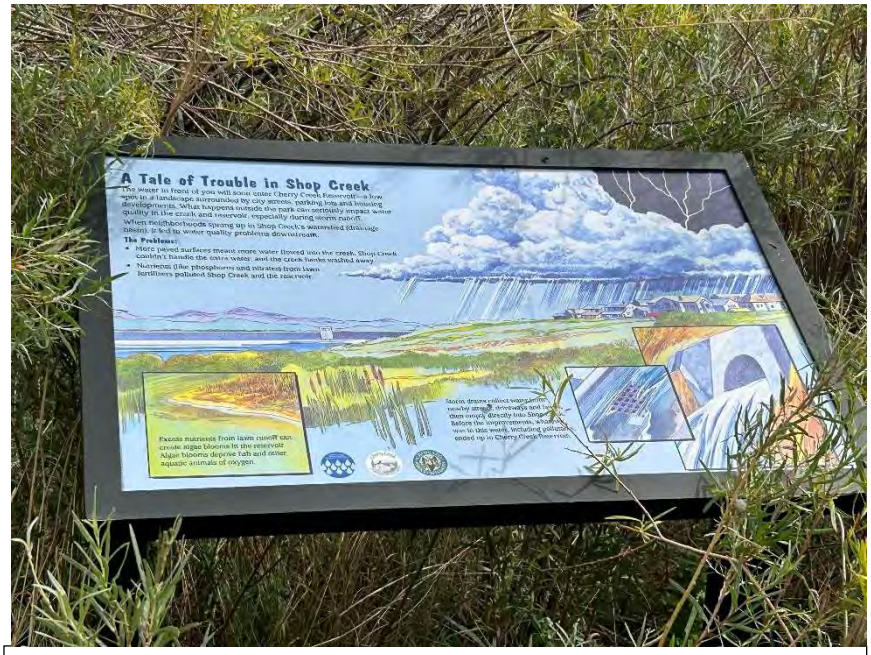
Drop No. 4 Outlet



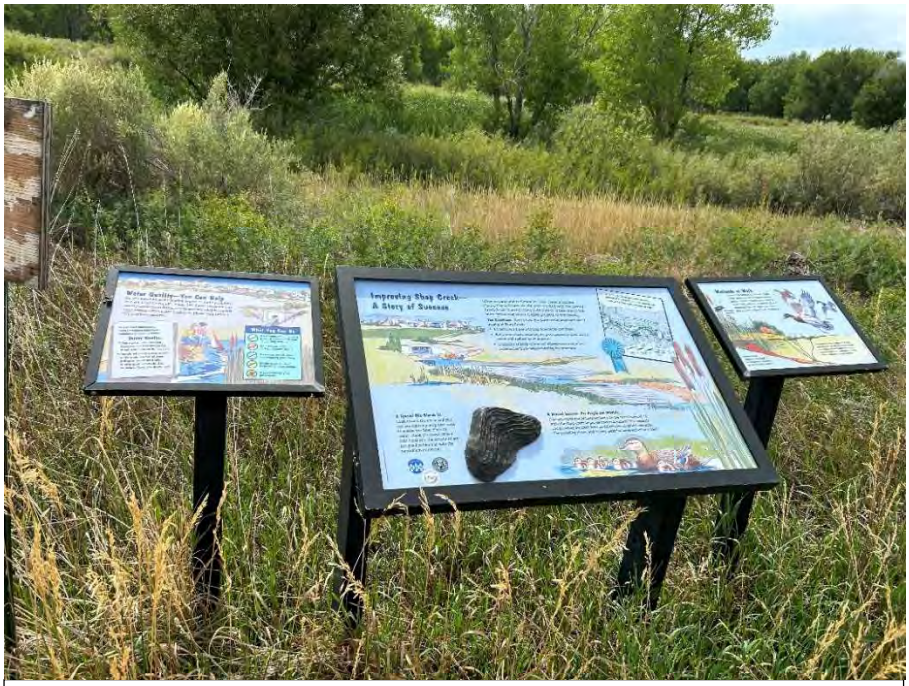
Drop No.5



Drop No. 5 Outlet

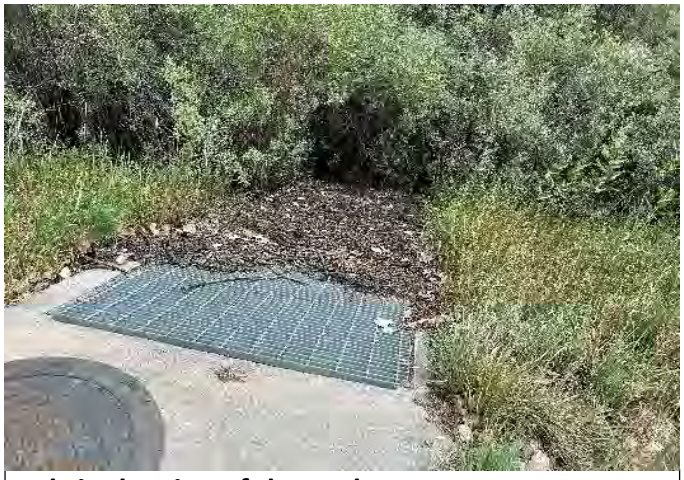


Shop Creek Informational Sign

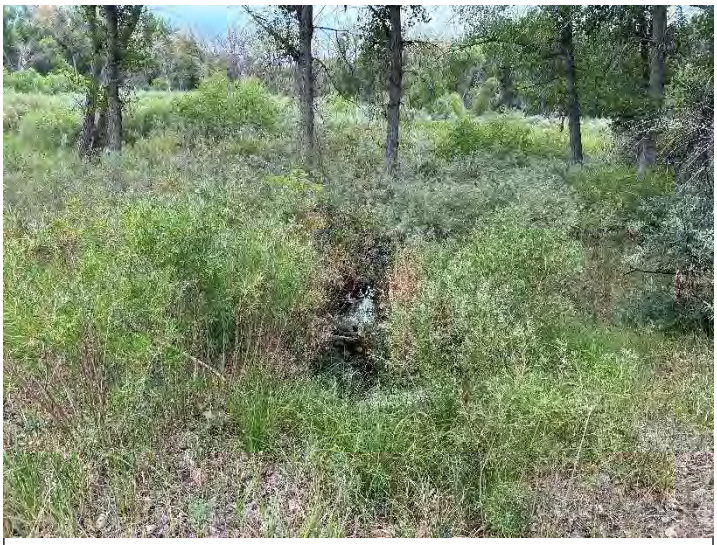


Shop Creek Informational Sign

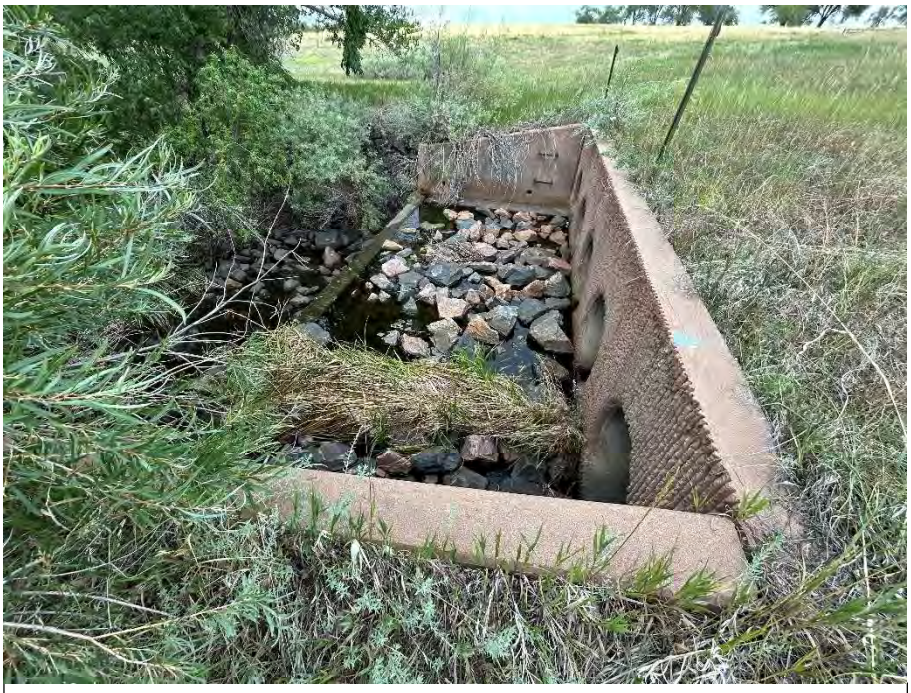
Quincy Drainage: Debris clogging was observed at the outlet structure, as were numerous plants growing in the energy dissipators of the outlet structure at the Lakeview Dr. crossing. These plants may need to be eradicated in the next couple of years. CCSP staff will take care of debris removal. At this time, no maintenance or repair needs were identified, except for weed control, although a capital project for stream reclamation may be needed in the future.



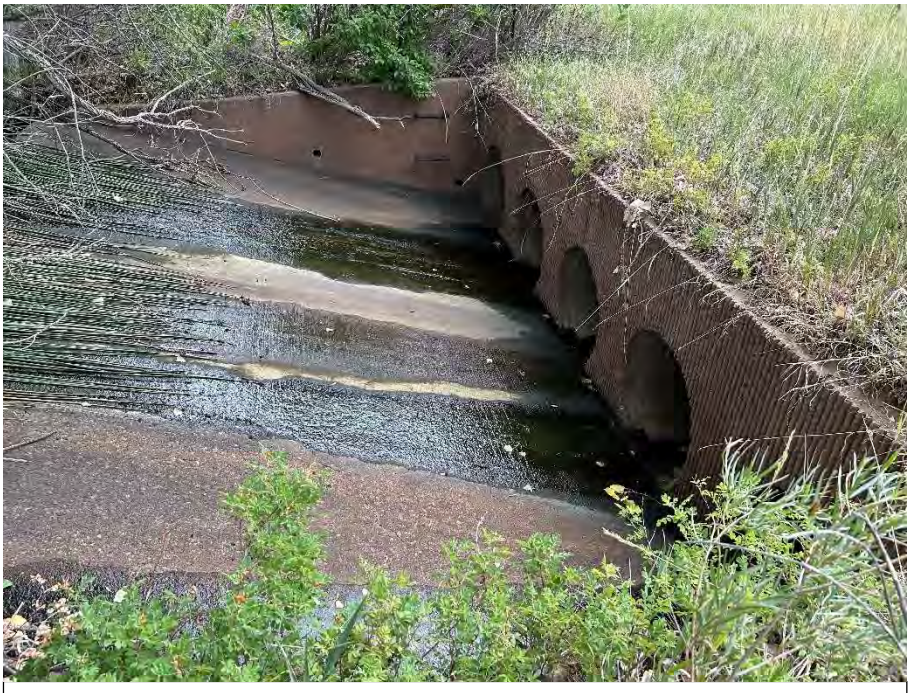
Debris clogging of the outlet structure



Outlet of the outlet structure

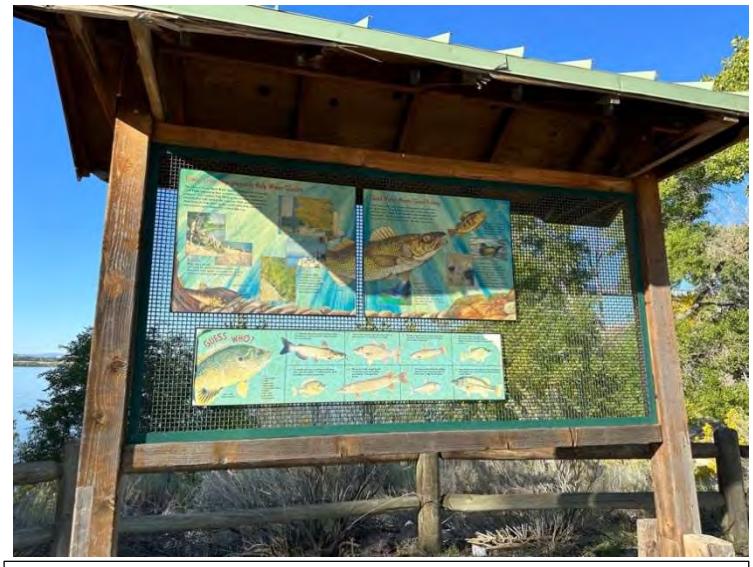


Outlet at Lakeview Dr. becoming clogged with plants

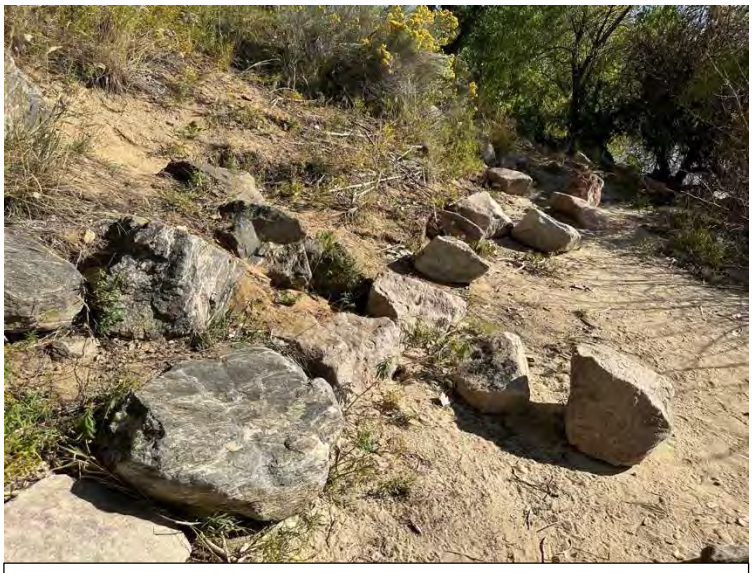


Inlet at Lakeview Dr. is clear

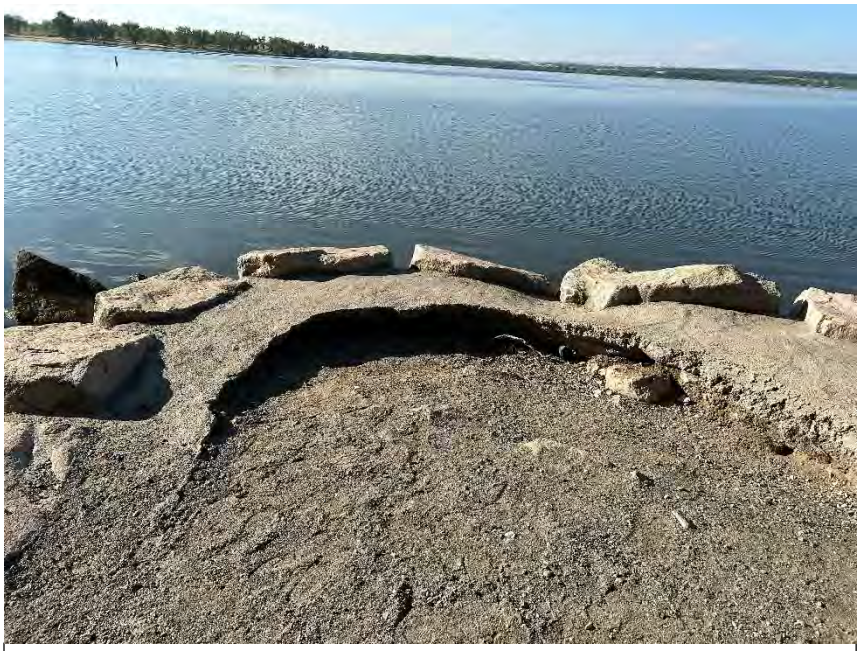
Tower Loop: This PRF consists of boulders and riprap stabilization of the shoreline. No new maintenance items were identified from that identified in the 2023 inspection, which was minor backfill of the boulder edging on the fishing promontories. That repair is under contract, but hadn't been done as of the date of this 2024 inspection. Some boulders were displaced but probably by human hands for seating purposes. The informational sign was in good shape and in no need of attention. The only maintenance identified for this project was some weed control.



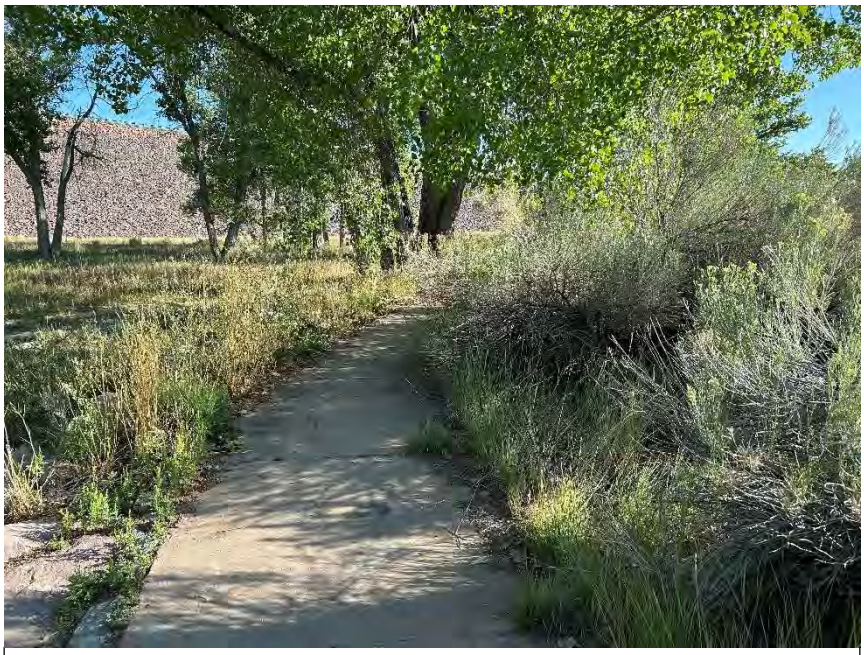
Informational sign in good condition



Human-displaced boulders

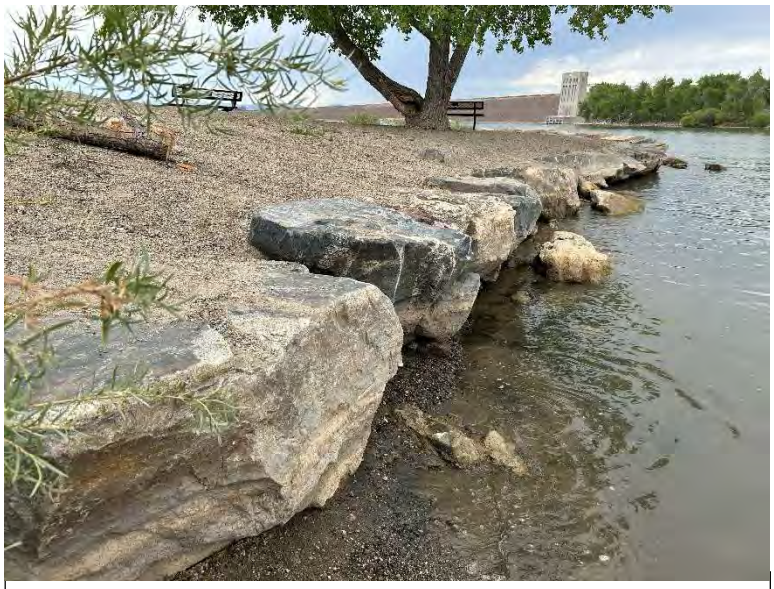


Eroded material from behind the grout at the fishing promontories-will be backfilled yet this year

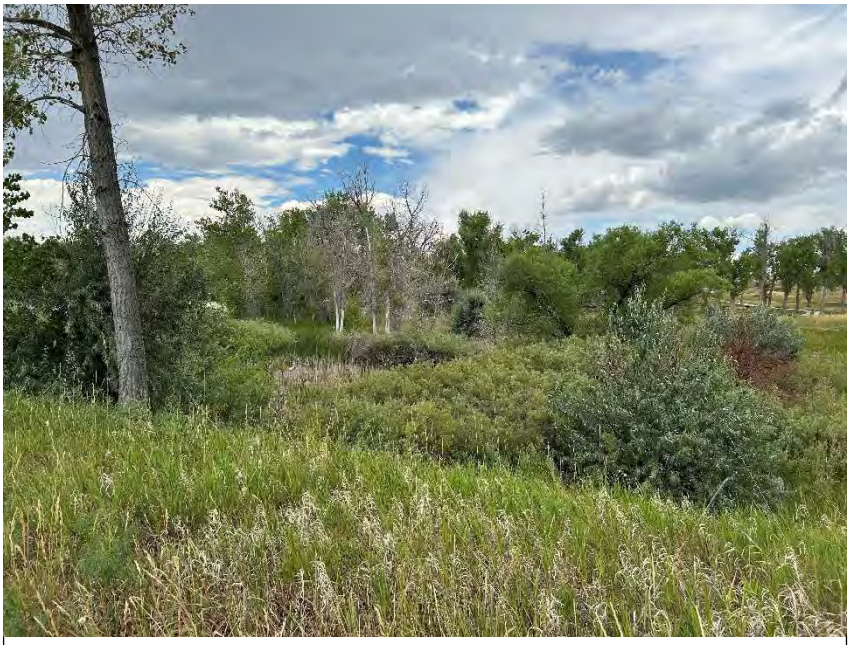


Spot weed control

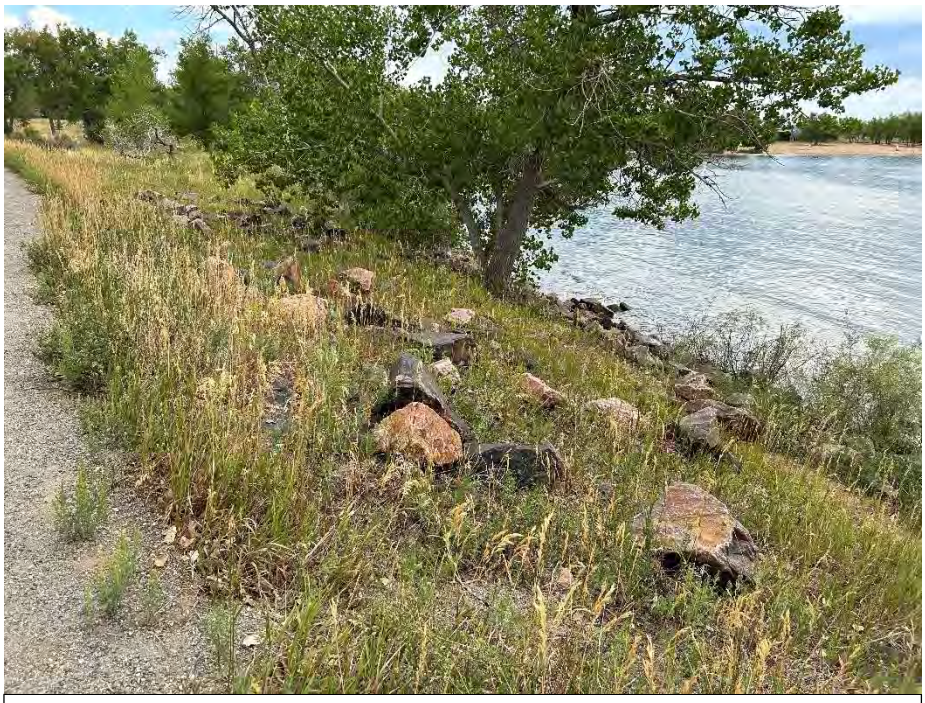
Dixon Grove: Boulders and riprap serve as protection of shoreline for this PRF. There is a water quality capture area that treats runoff from the parking lot that is appearing to function very well. The only maintenance needs that were identified was some spot weed control. The east shore of the large promontory appears to be beginning to be undercut, and should be considered for a future project. An area of shoreline south of the west shoreline stabilization area could also be a good candidate for a future shoreline stabilization capital project. Various dead trees and debris from the floods were identified for CCSP maintenance.



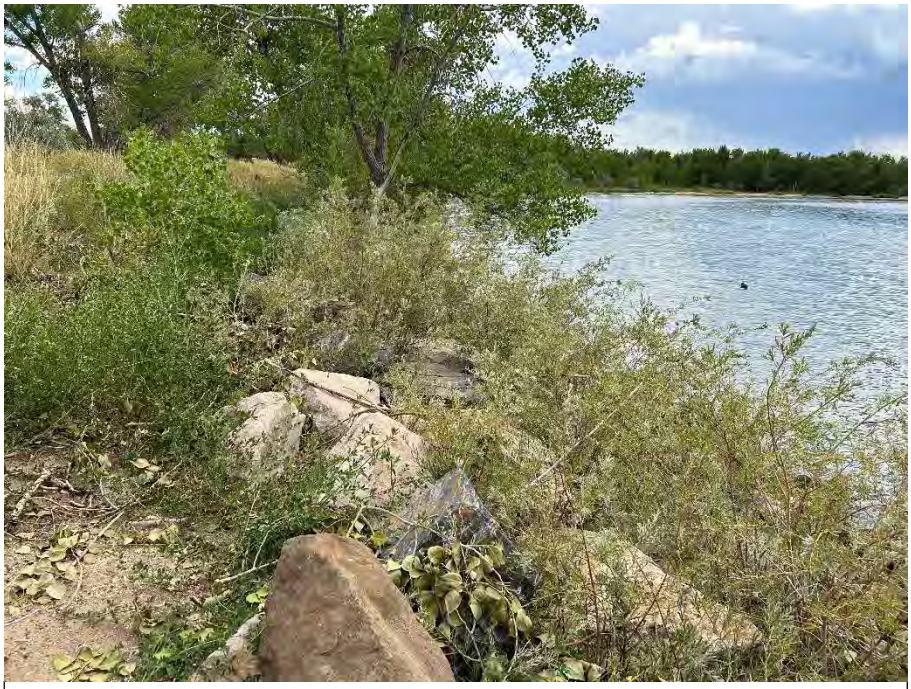
East Shore of Stabilized area showing the beginnings of boulder undercutting



Vibrant water quality capture area



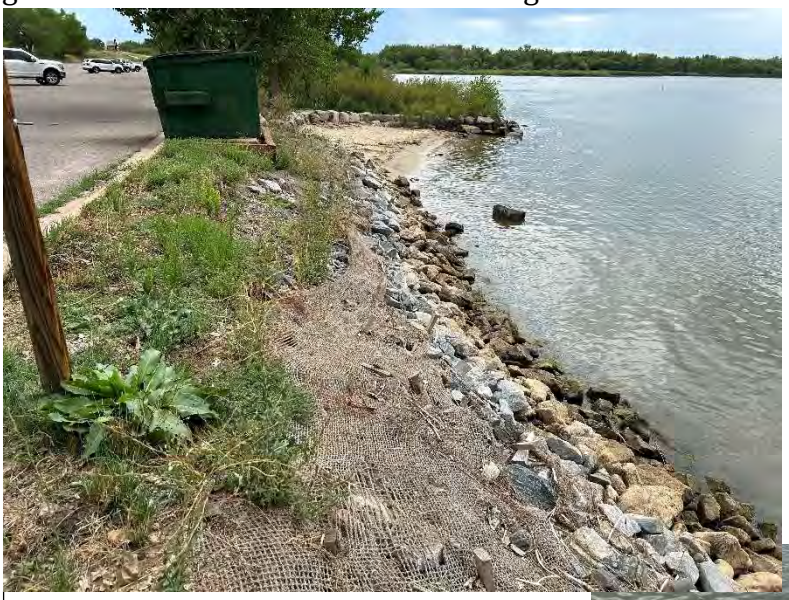
Area south as candidate for future Shore Stabilization CIP project



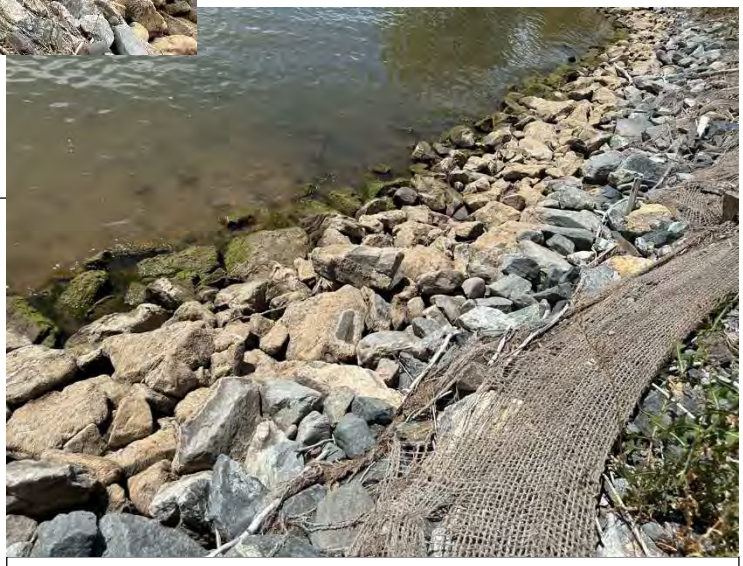
Area south as candidate for future Shore Stabilization CIP project

East Shade Shelters: The East Shade Shelters were not inspected this year because that entire area is under total reconstruction.

East Boat Ramp: Boulders and riprap serve as protection of the shoreline for this project. It is noted that the overly high reservoir levels, up to and exceeding the level of the parking lot in the floods of 2023 not only washed away the seeded area of the newly constructed project in 2022, but it also washed out the void filling of the Type M riprap. This gives cause to the concern that void-filling of riprap is not appropriate for shoreline stabilization. We are recommending, therefore, that the voids not be refilled as a repair project. Replanting of the vegetated area was recommended in 2023 as a 2024 project, but had not been done at the time of this inspection. The maintenance identified for 2025 for this area is new growth weed control to cover the revegetation area.

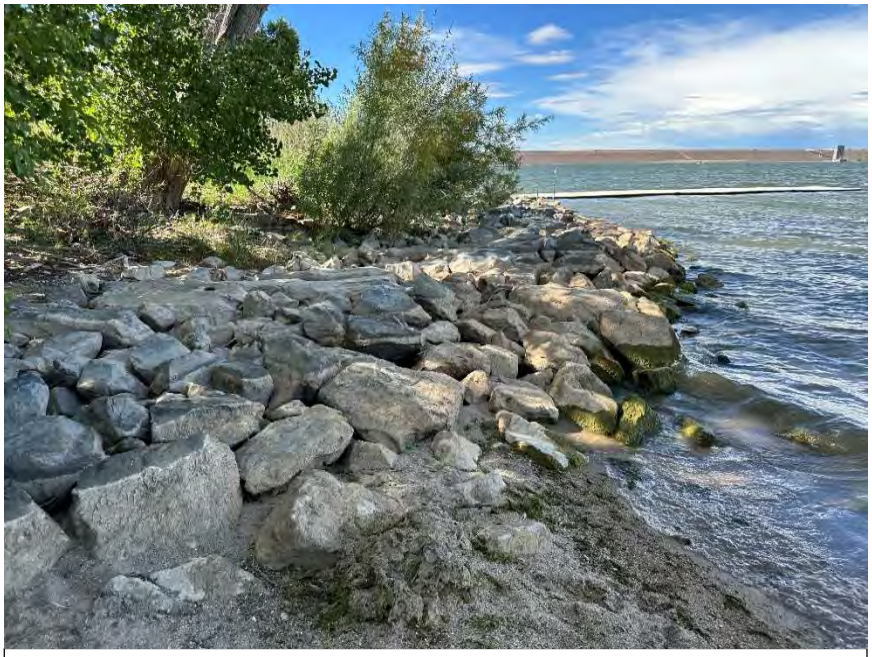


Reseed and mulching of this 2022 project, eroded by the floods of 2023 will be completed this year

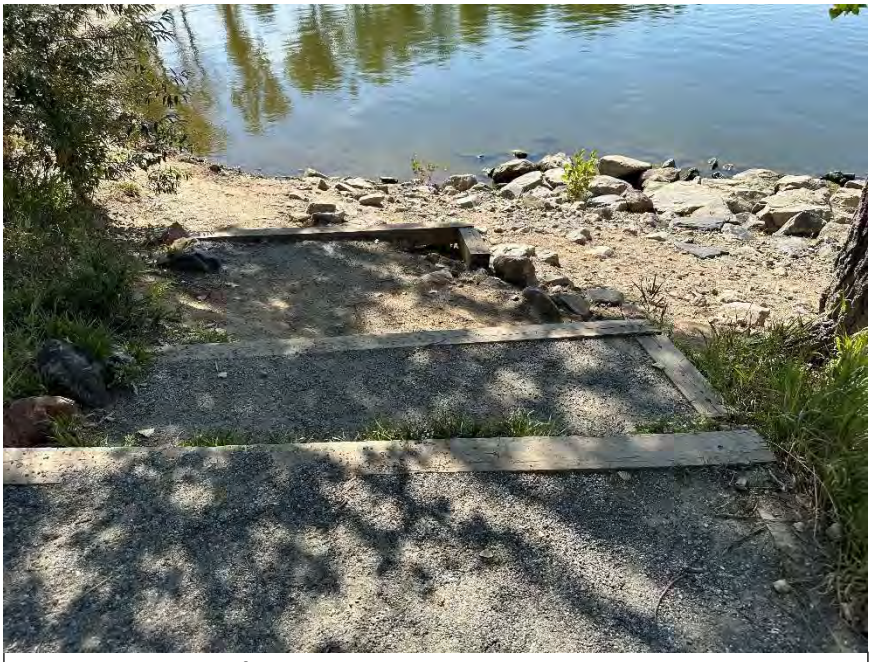


Riprap showing void-filling washed out

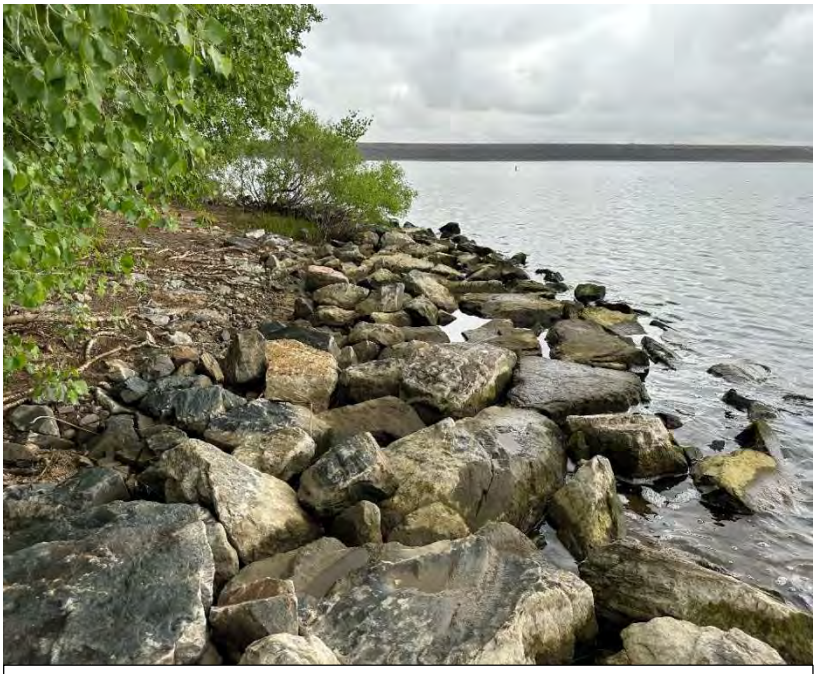
Mountain and Lake Loops: Boulders and riprap serve as protection of the shoreline for these facilities. As about 100 feet of shoreline southwest of the existing PRF has been eroding and exposing tree roots, a shoreline stabilization project was developed in 2022 for construction this year to be added to this PRF. The Authority decided, however, that the project should be put on hold due the low return on phosphorus stabilization. Bank erosion above the normal high-water line and trail material erosion was caused by overland flow from the floods running to the reservoir. The bank erosion should be monitored and CCSP should regrade the trails. No Authority maintenance needs were identified.



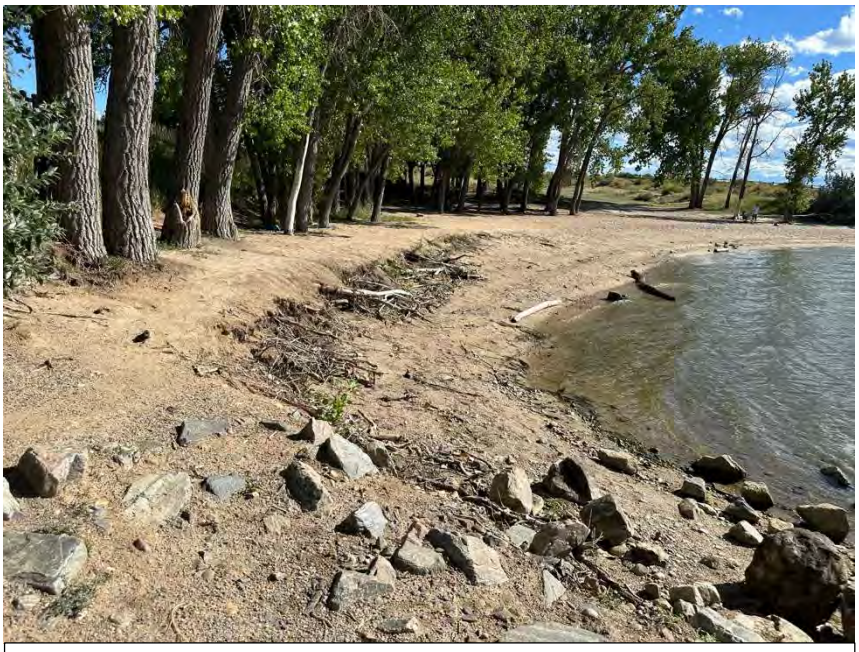
Shoreline riprap in good condition



Access steps need CCSP maintenance

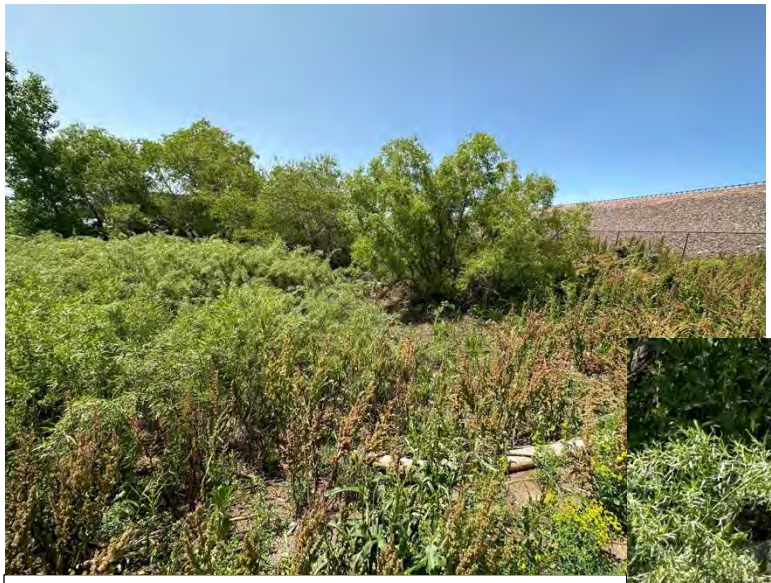


Current condition of shoreline stabilization

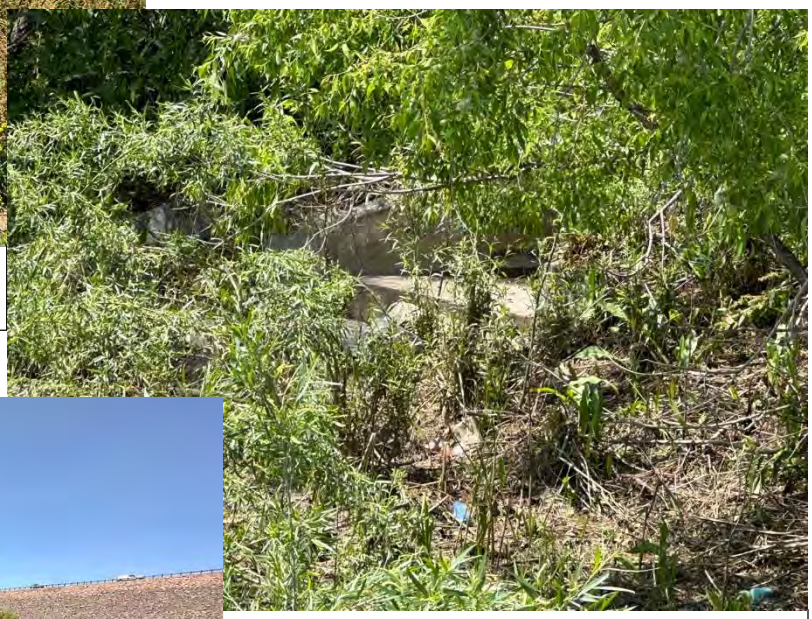


New area SW of the existing PRF originally contemplated for a shoreline stabilization project, but

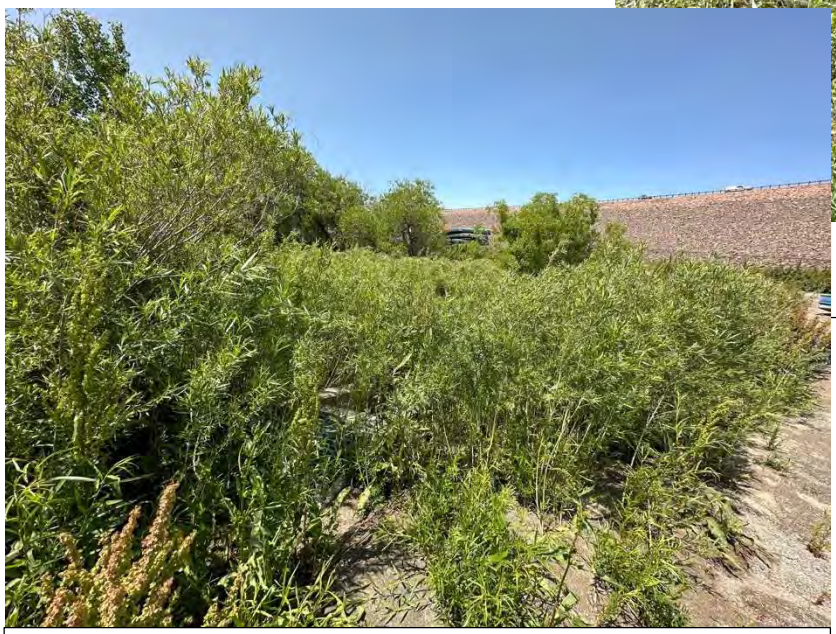
West Boat Ramp: All maintenance for this PRF is the responsibility of the CCSP. Maintenance identified for CCSP was cutting and clearing of all the vegetation inside the bounds of the pond, especially at the outlet.



Outlet clogged with plant material



Plant-clogged inlet



Total facility clogged with plants

Conclusions:

1. All the In-Park PRFs appear to be performing their functions well, with the exception of, possibly, the 12-mile Park projects.
2. The field observation general assessments include thoughts on maintenance, monitoring and planning efforts for future capital projects.
3. The summary of the maintenance work identified for consideration and budget estimates is shown in Appendix A of this report. The operations and maintenance costs developed from this 2024 Annual Field Inspection are $97,500 for Restorative and Rehabilitation work, and $15,000 for weed control.
4. Concerns and issues that were located outside limits of the original PRF or require additional analysis and study beyond the engineering already done on the original PRF were suggested as planning efforts. These planning efforts should include identification of the capital project, the priority, identification of the water quality benefits, and estimated costs. The identified planning efforts include:
    a. Cherry Creek 12 Mile Park-continued planning on Cherry Creek from Lakeview Dr. to CCSP Boundary, and an analysis of the goals and objectives of the original design concepts of the 12-mile park area as to the functionality and applicability of stabilizing and reclaiming a stream that is constantly changing its course in spite of all the control measures that have been applied to it, all to determine how restorative and rehabilitative measures should be applied.
    b. Dixon Grove and all shoreline stabilization projects- a planning effort to address new areas for shore stabilization, like the one to the south of the existing stabilized area at Dixon Grove, and all other areas from and including Tower Loop to Mountain and Lake Loops, and the appropriateness of the original design concepts, especially on rip-rap size and the use of void-filling, and how those concepts might need to change, especially in light of the effects of the two floods that occurred this year and what restorative and rehabilitative measures should be taken.
    c. Quincy Drainage-Planning for stream reclamation on Quincy Drainage from Lake View Dr. to the PRF outlet.

Appendix A

Cherry Creek Basin Water Quality Authority
Summary of 2024 Operation & Maintenance (O&M) Costs
Prepared / Updated: September 24, 2024

Project	Quantity			CCSP Work	CCBWQA Purchases Seed with CCSP Installation	CCBWQA Work					Comments	
	Each	Hours	Acres	Herbicide Application[1]	Tractor Reseeding (Seed Cost Only)[2]	Weed Control[1]	Tree Planting[3]	Shrub Planting[3]	Misc.	Restorative / Rehabilitation work[4]		
Shop Creek										$ -		
Cottonwood Wetlands				$ 1,000		$ 1,000				**$ 12,920.00**	PRF Routine, Decompaction and revegetation of access along embankment. Cleaning of outlet grate.	
Cottonwood Stream Reclamation				$ 2,000		$ 2,000				$ -		
Tower Loop				$ 1,000		$ 1,000						
Dixon Grove				$ 1,000		$ 1,000						
East Shade Shelter												
East Boat Ramp						$ 3,000					Weed Control for noxious weeds at 100% CCBWQA, since within 5 years of PRF construction.	
Mountain/Lake Loop Shoreline	1			$ 2,000		$ 2,000						
Quincy Drainage				$ 1,000		$ 1,000						
Cherry Creek 12-mile All Phases	1					$ 4,000				**$ 84,528.00**	Weed Control for noxious weeds at 100% CCBWQA, since within 5 years of PRF construction.	
Subtotal				$ 8,000	$ -	$ 15,000	$ -	$ -	$ -	$ 97,448		

Totals

CCSP =	**$ 8,000**
CCBWQA =	**$ 112,448**
Combined =	**$ 120,448**

Note 1. CCBWQA performs weed control (mechanical until native grasses mature, then herbicide) for first 5 years after PRF construction; afterwards 50/50 split between CCBWQA and CCSP.
Note 2. Reseeding Rate = $3,250/acre. CCBWQA purchases seed CCSP installs it with their tractor and the seed attachment purchased by CCBWQA.
Note 3. Tree Replacement = $1,300/ea. Shrub Replacement =$65/ea.. CCBWQA Participation @ 100%.
Note 4. PRF Function Repair/Maintenace. Project Specific Estimate. CCBWQA Participation @ 100%.

2024 PRF Field Observation
Cottonwood Wetlands 2025 Repair

Date: 10/24/2023

No.	Item	Quantity	Unit	Unit Price	Extension
1	Mobilization	1	LS	$ 500.00	$ 500.00
2	Decompaction	0.2	AC	$ 6,500.00	$ 1,300.00
3	Reseeding and Mulch	0.2	AC	$ 6,500.00	$ 1,300.00
4	Clean out Outlet Structure	2	EA	$ 3,000.00	$ 6,000.00
5	Remove material from flood storage pool per USACOE	0	CY	$250	$ -

Subtotal		$	9,100.00
Contingency	20%	$	1,820.00
Subtotal		$	10,920.00
Surveying			
Engineering, Permitting & Const Svs		$	2,000.00
Total Estimated Construction Cost		**$**	**12,920.00**

2024 PRF Field Observation
Cherry Creek 12-Mile 2025 Repair

Date: 9/24/2024

No.	Item	Quantity	Unit	Unit Price	Extension
1	Mobilization	1	EA	$ 4,100.00	$ 4,100.00
2	Remove and Reinstall Existing Type 1 Fence for Access	50	LF	$ 24.00	$ 1,200.00
3	Remove and Reinstall Existing Massive 2-Rail Fence for Access	50	LF	$ 56.00	$ 2,800.00
4	Remove Existing Type 1 Fence (north end)	50	LF	$ 12.00	$ 600.00
5	New Massive 2-Rail Fence	85	LF	$ 90.00	$ 7,650.00
6	Erosion Control Log	1000	LF	$ 6.00	$ 6,000.00
7	Soil Amendments and Seedbed Prep	0.4	AC	$ 4,000.00	$ 1,600.00
8	Seed	0.8	AC	$ 4,000.00	$ 3,200.00
9	Straw Mulch	0.7	AC	$ 4,000.00	$ 2,800.00
10	Erosion Control Blanket	631	SY	$ 16.00	$ 10,090.67
11	Relocate in-stream riprap	8	CY	$ 250.00	$ 2,000.00
12	Access 4 boulder backfill	15	CY	$ 150.00	$ 2,250.00
13	Construction Fence	150	LF	$ 8.00	$ 1,200.00
14	Area Closed for Restoration Signs	3	EA	$ 400.00	$ 1,200.00
15	Bolster logjam	1	EA	$ 10,000.00	$ 10,000.00
16	Forensic Design study	1	EA	$ 10,000.00	$ 10,000.00
15	Remove material from flood pool per USACC	15	CY	$ 250.00	$ 3,750.00

Subtotal		$ 70,440.67
Contingency	20%	$ 14,088.13
Subtotal		$ 84,528.80
Surveying		
Engineering, Permitting & Const Svs		$ -
Total Estimated Construction Cost		**$ 84,528.80**

Appendix B

WWE

MEMORANDUM

To: Jane Clary
Cherry Creek Basin Water Quality Authority Technical Manager
Wright Water Engineers, Inc.
Via email: clary@wrightwater.com

From: Wright Water Engineers, Inc.
Andrew Earles, Ph.D., P.E.

Date: August 28, 2024

Re: Cherry Creek channel geomorphology observations in vicinity of Dog Off Leash Area

This memorandum summarizes observations from a field visit to Cherry Creek in the vicinity of the Dog Off Leash Area (DOLA) on August 27, 2024. Participants in the field visit included Elysa Loewen of Loewen Engineering, Inc., Rick Goncalves of RG and Associates, LLC, and Andrew Earles of Wright Water Engineers. Inc. (WWE). The objective of the field visit was to answer the following questions:

1. Are there near-term operations and maintenance (O&M) activities that could serve as a band-aid until a more thorough evaluation/plan can be developed? Are there areas where revegetation, moving boulders, or other O&M activities would benefit stream stability and water quality?

2. What are suggestions for scoping a follow-up study/evaluation, understanding that this is one hot spot in a larger system, and we are currently prioritizing Reach 1 between Lakeview Drive and the Reservoir? It may be a few years before "real work" on this segment occurs.

Figure 1 shows the general area toured. This is a very dynamic reach of Cherry Creek that still shows the effects of the two large floods that occurred in 2023. While the primary focus of the field visit was to evaluate the area where Cherry Creek has avulsed from the rock lined channel and is now flowing along a new active channel alignment, this memorandum provides observations related to all of the areas visited. The following observations are presented from upstream to downstream

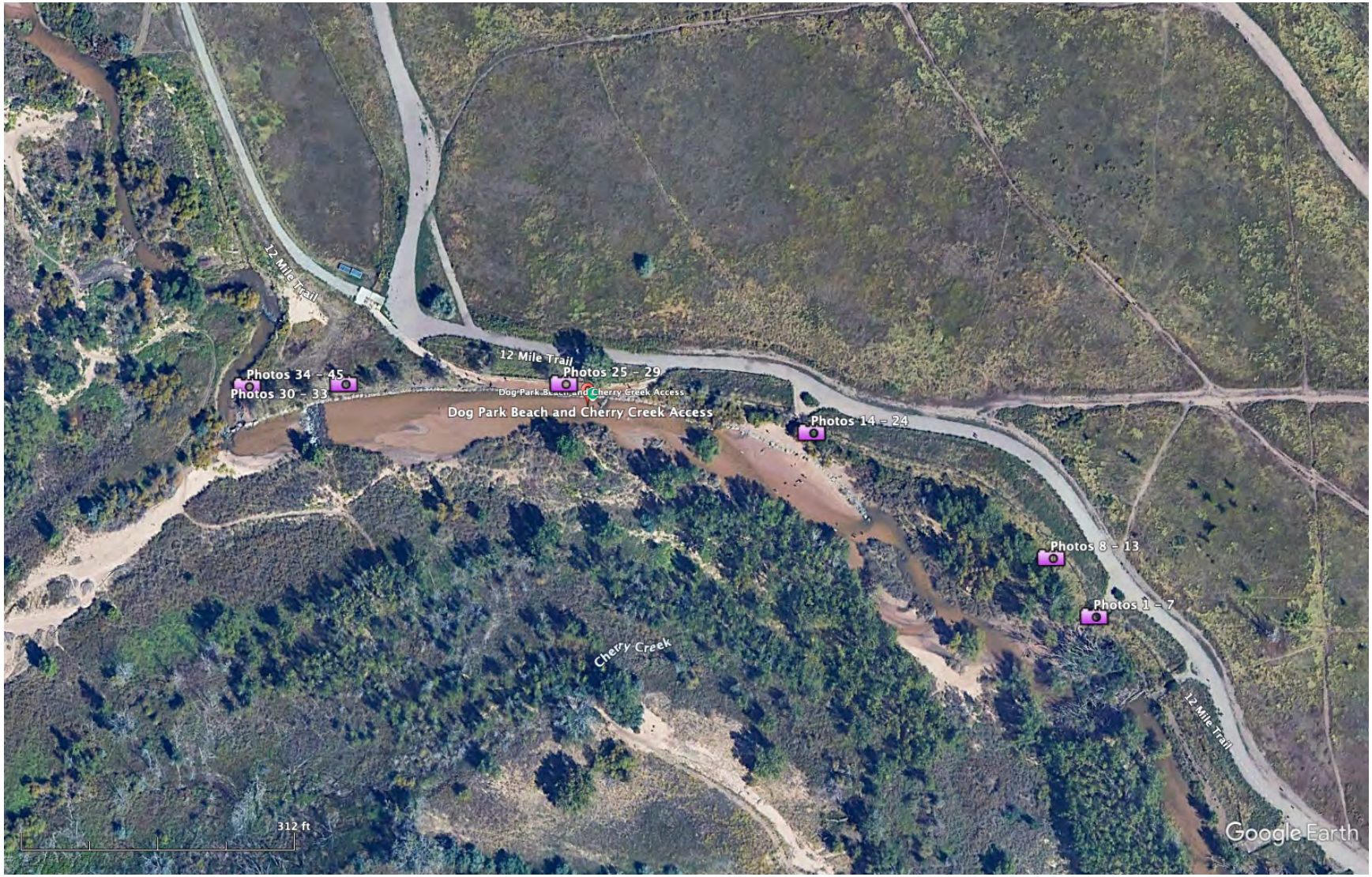


Figure 1. Area visited during August 27, 2024 site visit (Note: photographs in appendix are generally organized from upstream to downstream (right to left in this image)

1. Near the upstream end of the reach, there is a significant log jam, presumably from flooding in 2023 (see photos 1 – 7). The log jam pushes flow in the creek to the west and appears to be acting as a grade control structure. Downstream of the log jam, the sand bed channel has incised by several feet, leaving "islands" of higher ground around trees where sediment is held in place by roots. Removal of the log jam would be a major effort going beyond O&M, and with the stabilizing function the log jam is currently providing, removing this may not be advisable. As a part of studying this reach in the future, it would be worth evaluating the stability of this area. If the log jam is well anchored, perhaps it could be reinforced to act as a grade control in the long term. Removal of the log jam would likely mobilize significant amounts of sediment and would leave behind an area in need of stabilization.

2. Downstream of the log jam, the channel appears to have degraded by two to three feet judging from the depth of sediment remaining around some of the trees (see photos 8 - 13). Some trees may be undermined and lost in future flood events and some of the vegetation on the banks may be stressed by the lowering of the water table. Revegetation of banks that are now exposed due to the channel incision could be considered for a short or long term project. Using willow staking could be an effective practice based on stands of willows along some sections of the creek.

3. The next area visited was a large beach area that is very popular with human and canine users of the area (see photos 14 - 24). This section of creek was lined with large boulders along the outer edge of a bend in the stream alignment, although the low flow channel alignment has since shifted from its initial design alignment in this area now having the outer channel bend on the far bank (south) with sand deposition zones just inside the boulder lining. In recent floods, water got above these boulders and appears to have eroded some of the material in the floodplain bench behind the boulders, leaving some geotextile exposed. Some erosion along the far bank (south) where the outer bend has shifted was also observed, We discussed the potential for stabilizing some of the floodplain bench area with vegetation, which would require soil amendment or importing topsoil. Establish vegetation in this beach area would need to balance the stabilization objectives of revegetation with the active use of this area. Overall, the group felt that this area was a lower priority than others because it clearly serves its recreational objectives as a beach area and there are other areas along the creek with much more substantial erosion. Some erosion protection along the far bank could be considered as a maintenance activity or as part of a capital project.

4. Moving further downstream, the group visited the area where the multi-use path runs along a floodplain bench on the north side of the creek (see photos 25 - 29). Some material has washed out from behind the boulders lining the bank and is leading to some undermining of the path. Rick stated that there is a maintenance project out for bids to fill in this area with rock with a d_{50} of 2 inches, which will help shore up the multi-

use path. The bendway weir in this location appears to be doing an effective job of redirecting the current toward the main channel and away from the outer bend.

5. The next area visited was the drop structure that was constructed as a part of Phase 3 of the channel improvements in this area (see photos 30 - 33). The drop structure appears to be in good condition, although it appears that some of the Riprap used to construct the drop have been deposited downstream of the structure (see photos 30 and 31). Upstream of the drop structure, the creek appears to flow towards the south bank; Elysa confirmed with record drawings for the Cherry Creek at 12-mile Phase 3 project that the sheet pile for the drop structure does extend approximately 93-ft beyond the south channel bank to protect from the channel eroding around the drop. In addition, it appears that some bank material may have been washed out from the bank on the opposite side of the creek, just downstream of the drop. Replacing the rock that has been dislodged from the drop structure and repairing bank erosion on the far bank could be considered as maintenance projects. The drop structure appears to be performing as intended, so repairing the drop and bank erosion would be good expenditures of O&M funds.

6. Downstream of the drop structure, the channel has avulsed from its historic flow path to the north (see photos 34 - 45). The flow undermined the rock-lined northern bank of the creek, and a new channel has formed. The previous main channel has been filled in with sediment, and the channel that was created by this avulsion is now actively shaping itself. Downstream of avulsion, we observed steep cut banks, as well as a drop naturally forming in the channel bottom due to less erodible claystone bedrock in the channel. The channel flows generally to the north from the avulsion with several sharp eroding bends observed during the site visit. While the old main channel now appears abandoned, it likely would serve as an active flow path in a large flood event in addition to the new channel. Work to repair the breached boulder channel bank and convert this into a formalized grade control structure would require heavy equipment. This may be advisable in the long-term but goes beyond an O&M project. We also noted a rock bar across part of the channel downstream of the avulsion area (see photos 40 – 43 and 45). It appears that this is a deposit of material washed out from upstream. The avulsed channel appears to lose a lot of grade over a short distance, so turning this into a formal grade control structure also could be a good maintenance project. At the point of avulsion and in the channel downstream, there are several locations where the channel significantly narrows as it goes around sharp bends. One alternative to consider in these areas is grading back the banks to lessen the constriction. This would help to reduce velocities through the areas, and high flow path cutting off bends could be evaluated and armored to avoid excessive erosion in flood events. We also discussed collecting samples of exposed claystone bedrock material along the banks of the channel downstream of the avulsion to better assess the phosphorus content and risk of phosphorus loading downstream.

7. Downstream of the avulsion, we observed erosion along the outer banks of the sharp bend downstream of the deposit of rock material (rock bar). The area looks to be actively eroding and should continue to be monitored for bank loss and proximity to an adjacent pedestrian trail.

8. Near the downstream reach, there is an area that appears to be struggling to establish healthy vegetation that is not weeds. Based on discussions during the site visit, this may have been used as a staging area in the past. This is a sandy overbank deposit with little apparent organic material, which is likely one reason that vegetation has not reestablished. A good maintenance project for this area would be amendment of the sandy soil in accordance with MHFD's Topsoil Guidance and reseeding in the fall, when conditions are appropriate.

Based on these observations, there are several opportunities for O&M projects that would be beneficial to channel stability and, as a result, water quality. These include replacing rock that has been washed downstream of the Phase 3 drop structure and repair of bank erosion in this area. Backfilling the area between the rock bank and the multi-use path with 2-inch d_{50} material falls in the O&M category, and this project is currently out for bids. Finally, extending the current rock bar (riprap washed out from upstream) in the lower reach across the creek to create a drop structure could be considered as a maintenance project. There is good access to this area. Other needed repairs, such as stabilizing the area where the creek has avulsed to the north, would require heavy equipment and would be more on the scale of a capital project than an O&M activity. It was clear to the group on the site visit that a comprehensive study is needed to better understand the sediment transport dynamics and geomorphology of this reach. With a sand bedded channel and sandy bank materials in many locations, hard armoring of the channel, to the extent this is considered, must be carefully evaluated because the creek is likely to find new areas to erode as other areas are hardened. Such a study should begin downstream of the avulsion reach and extend upstream through the 12 Mile reach. The study team should include a geomorphologist in addition to engineers who can think through the potentially unintended consequences of stabilizing some areas but not others. This area must be studied in a holistic fashion instead of project-by-project.

Attachment

Photographs from August 27, 2024 Site Visit

cc: Elysa Loewen, Loewen Engineering, Inc., eloewen@loeweneng.com
Rick Goncalves, RG and Associates, LLC., rickg@rgengineers.com

Appendix A: Photographs from August 27, 2024 Site Visit

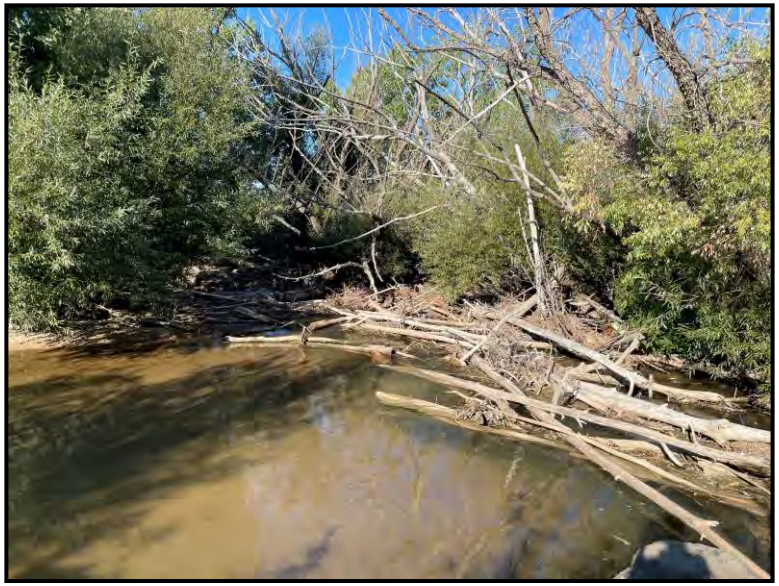
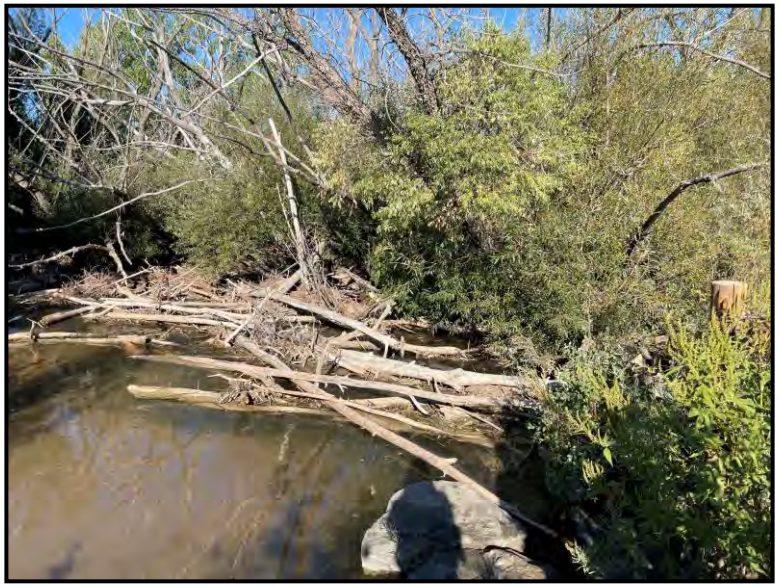


Photo 1.



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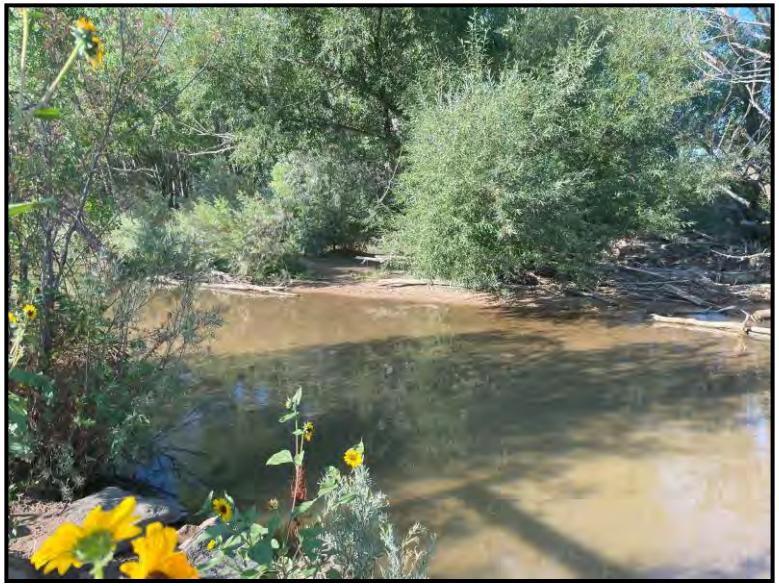

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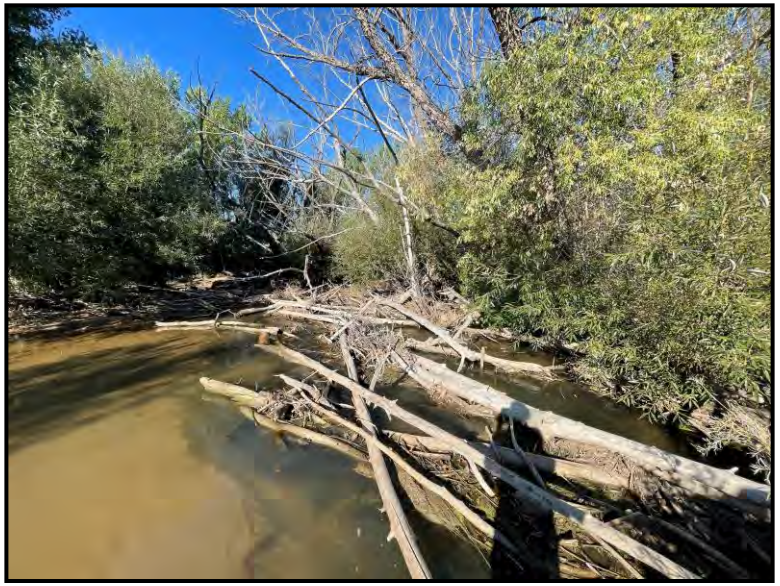
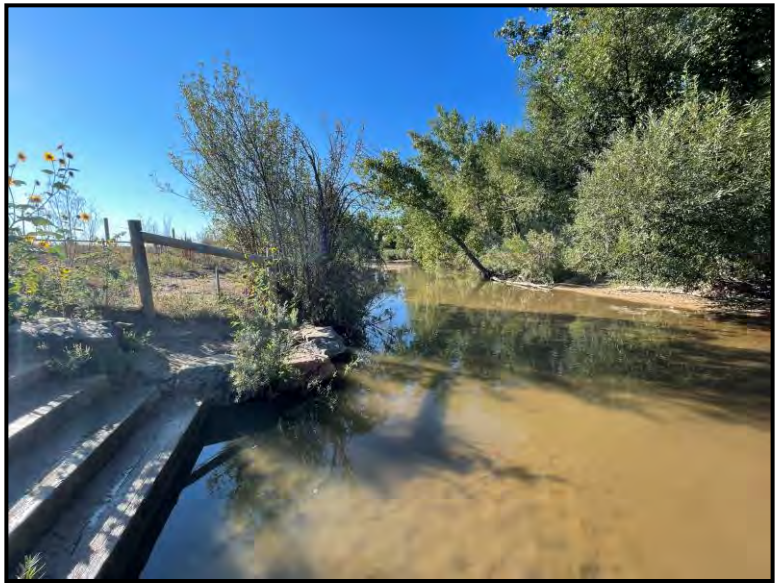


Photo 4.

Photographs taken by Wright Water Engineers, Inc.

Appendix A: Photographs from August 27, 2024 Site Visit



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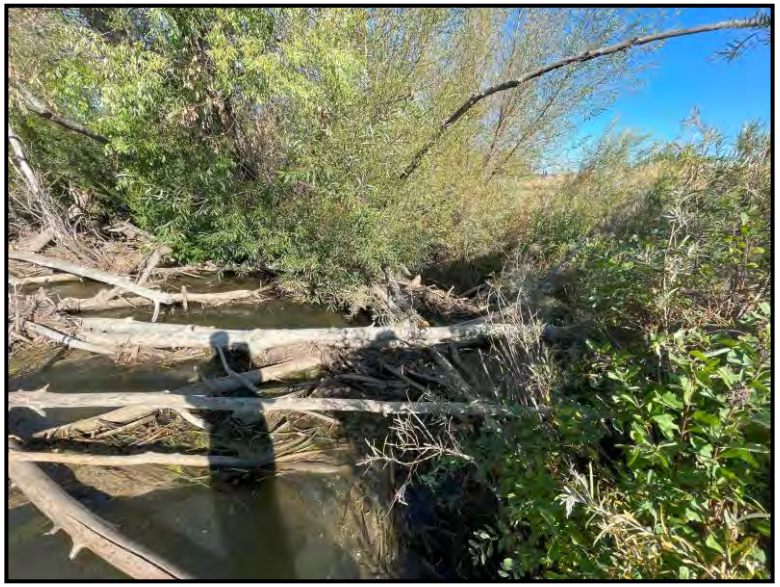

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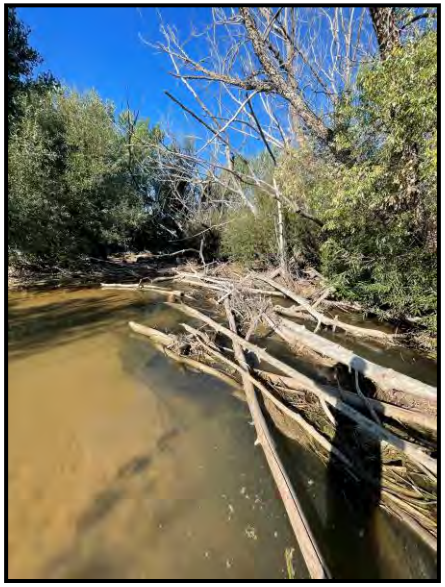

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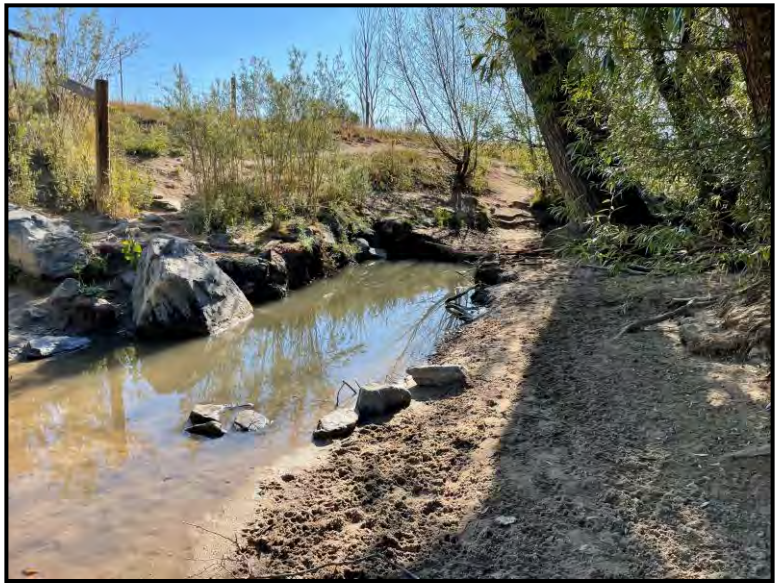

Photo 8.

Photographs taken by Wright Water Engineers, Inc.

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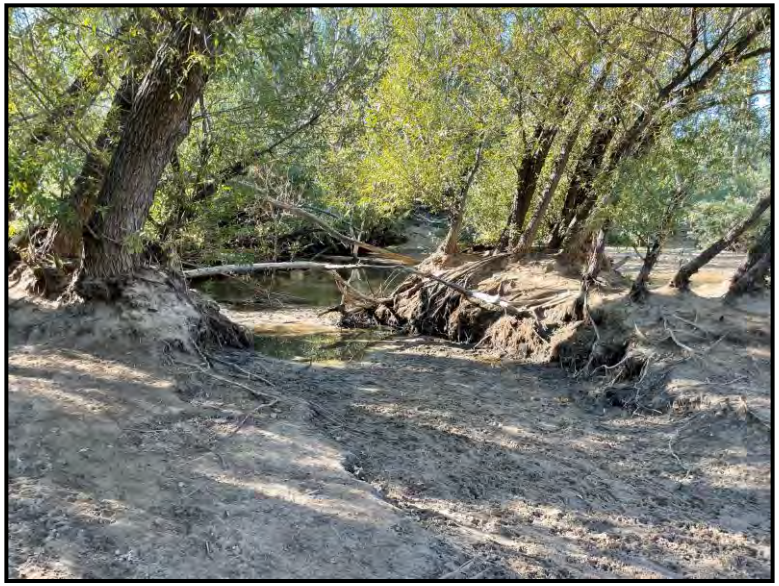

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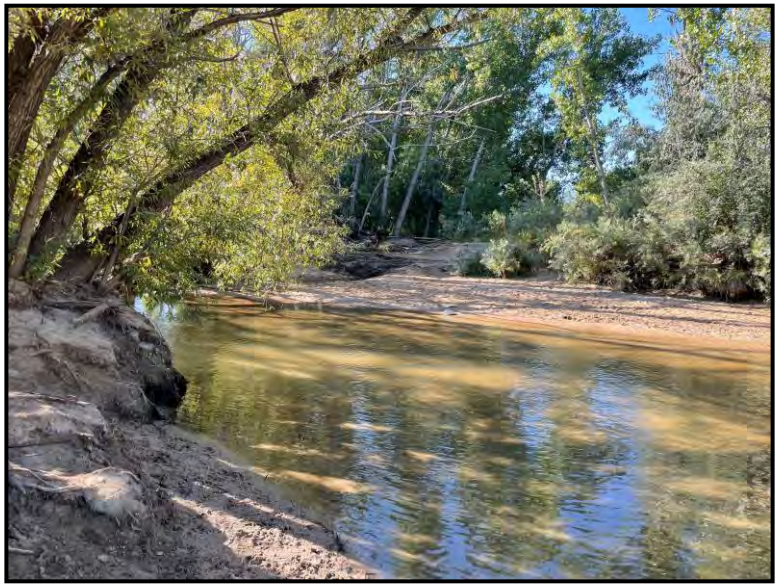

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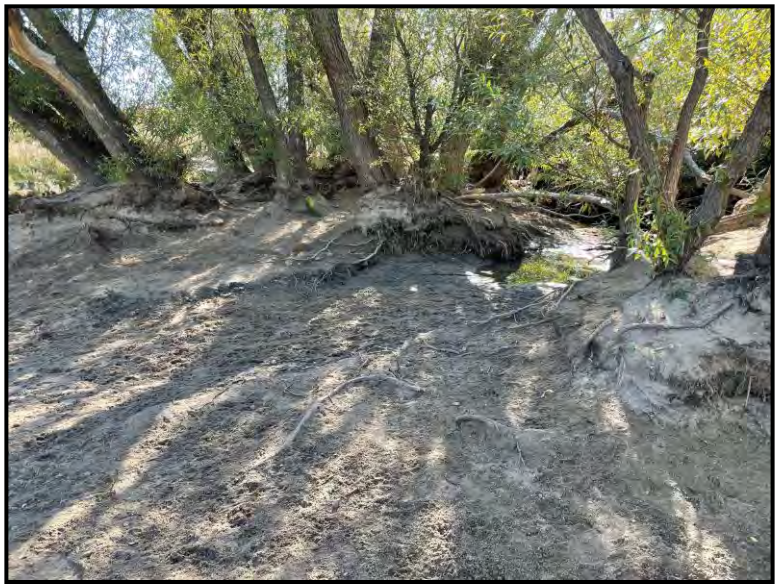

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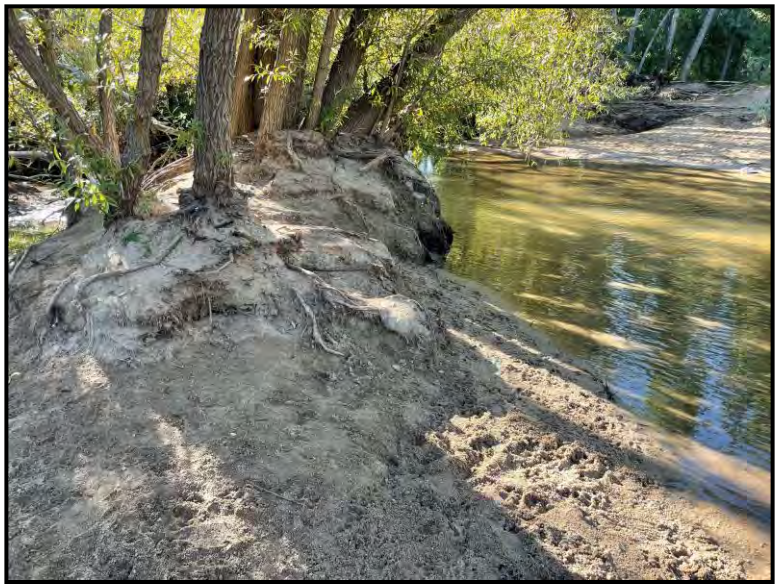

Photo 12.

Photographs taken by Wright Water Engineers, Inc.

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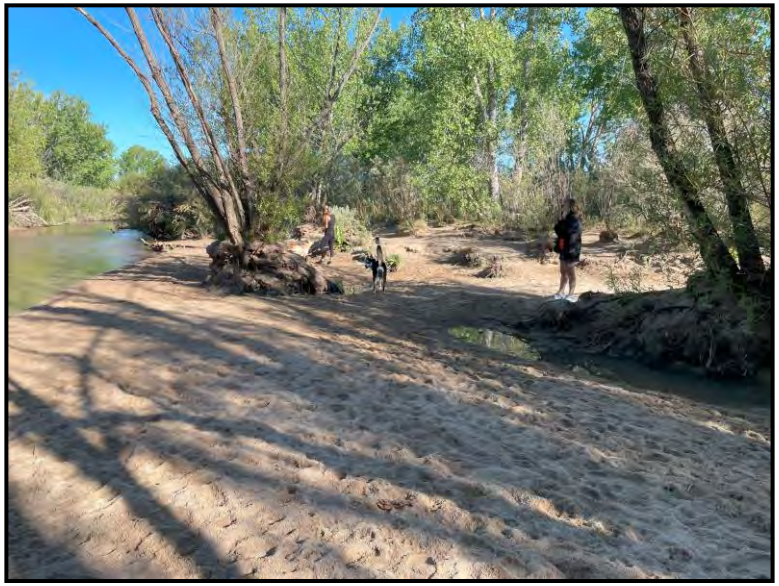

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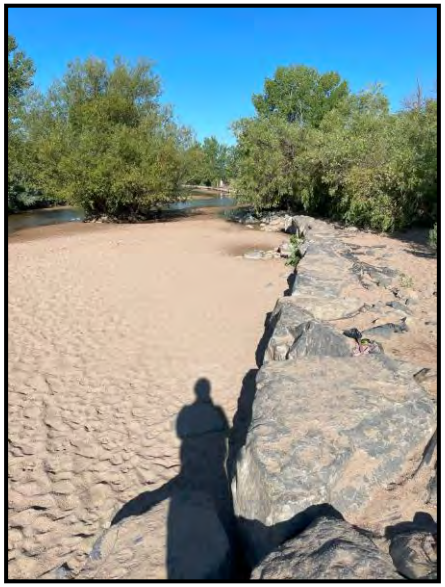

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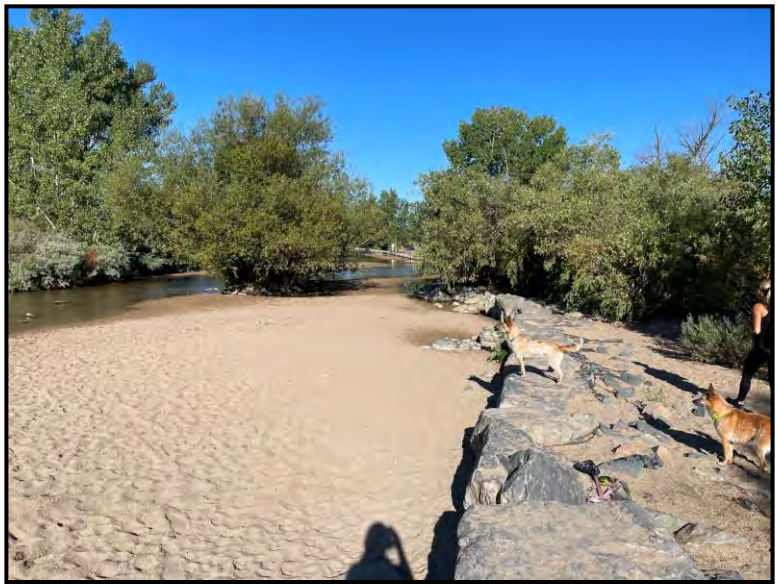

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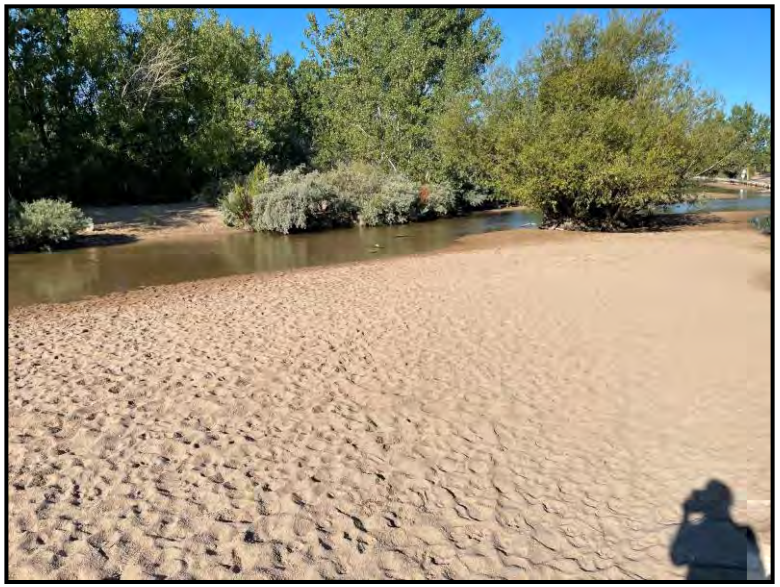

Photo 16.

Photographs taken by Wright Water Engineers, Inc.

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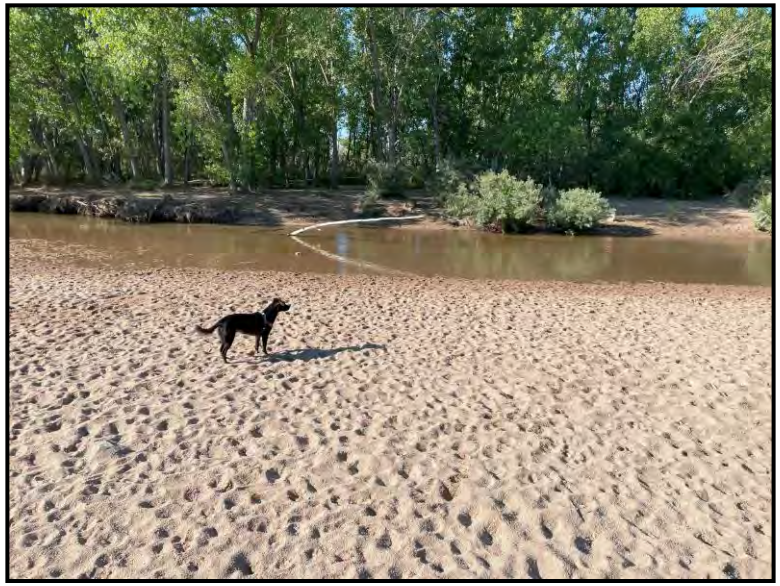

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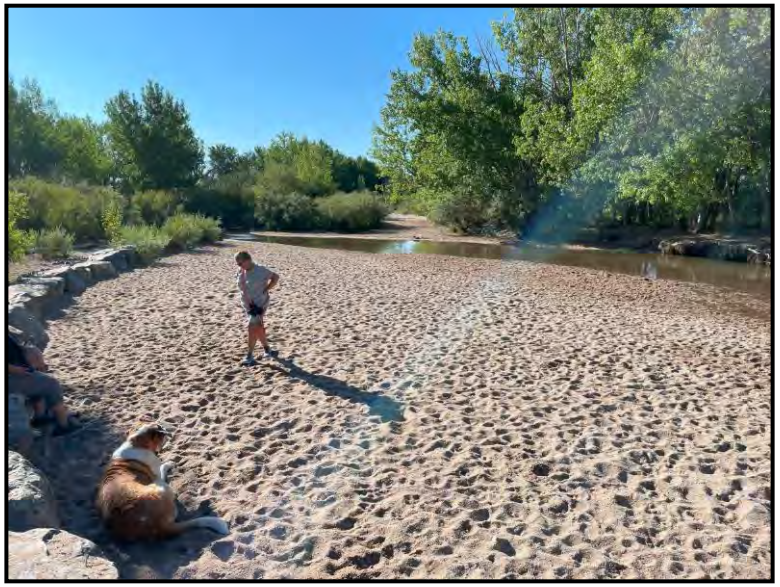

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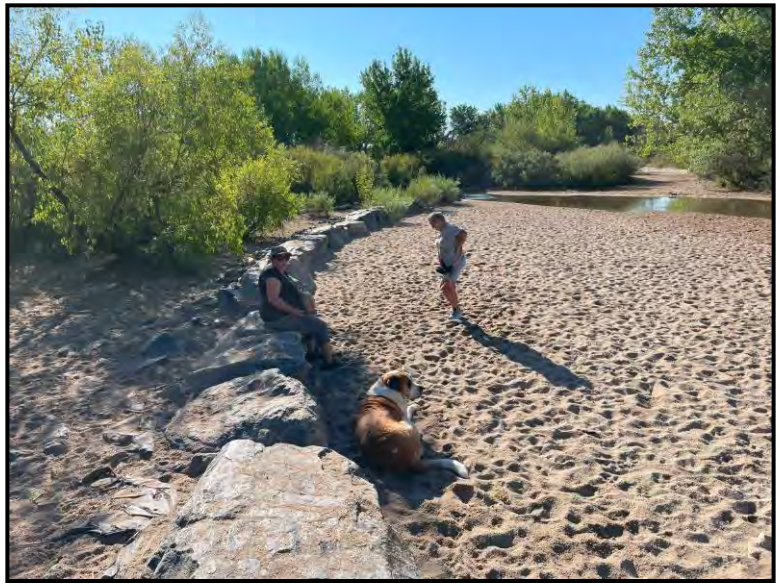

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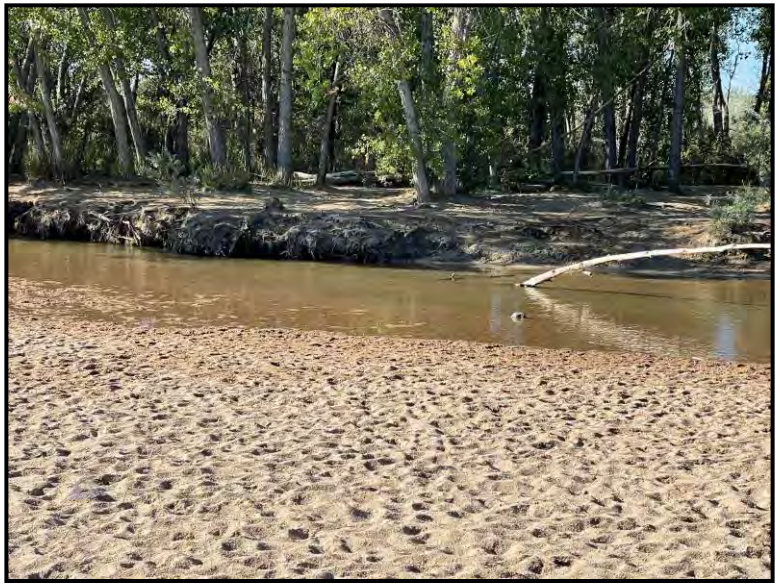

Photo 20.

Photographs taken by Wright Water Engineers, Inc.

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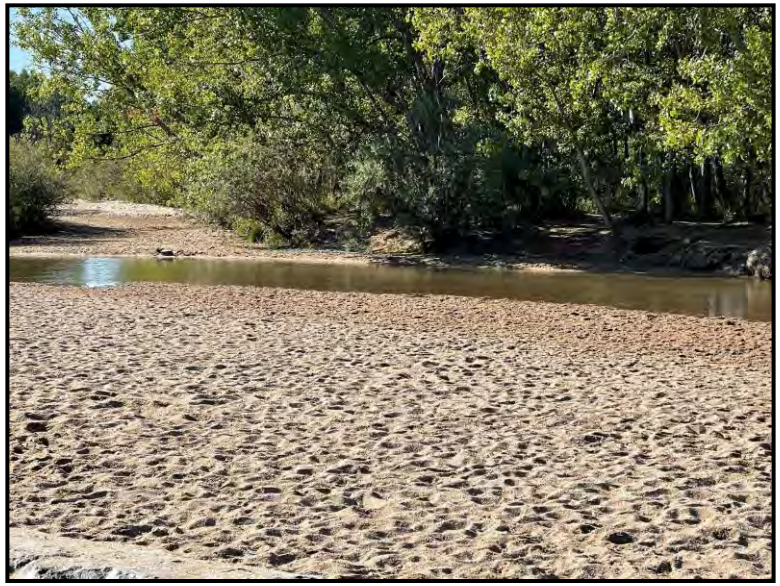

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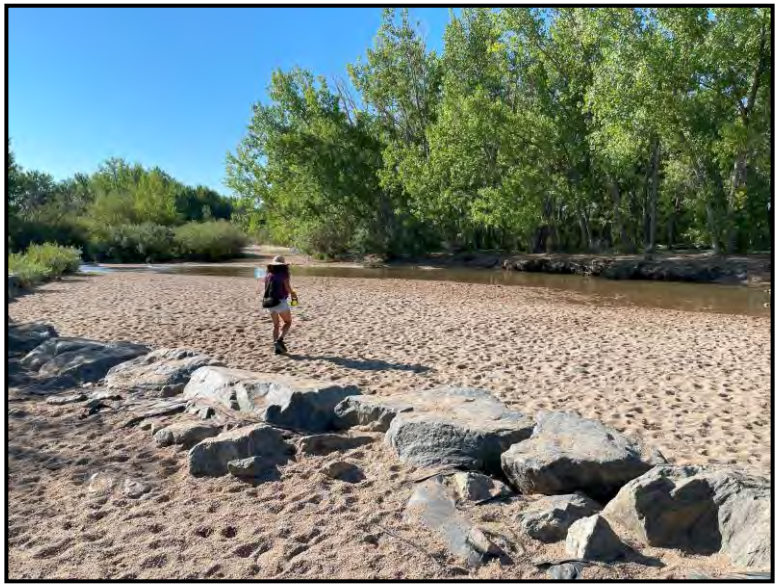

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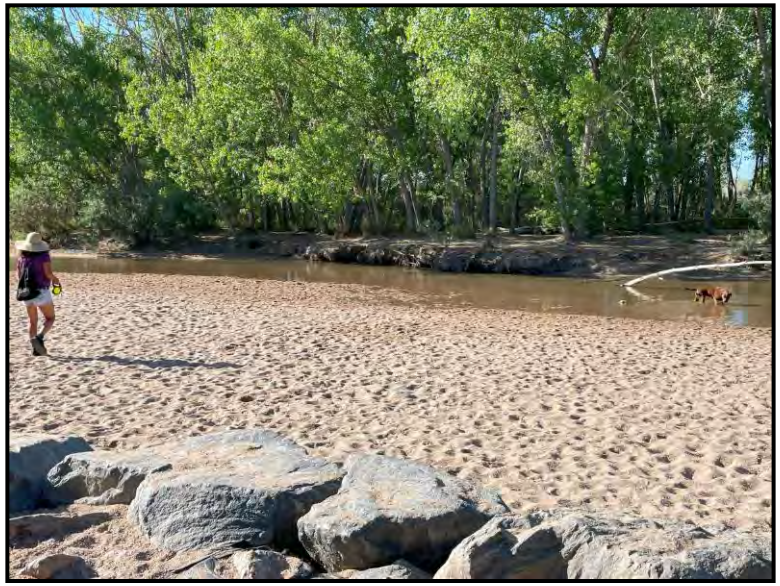

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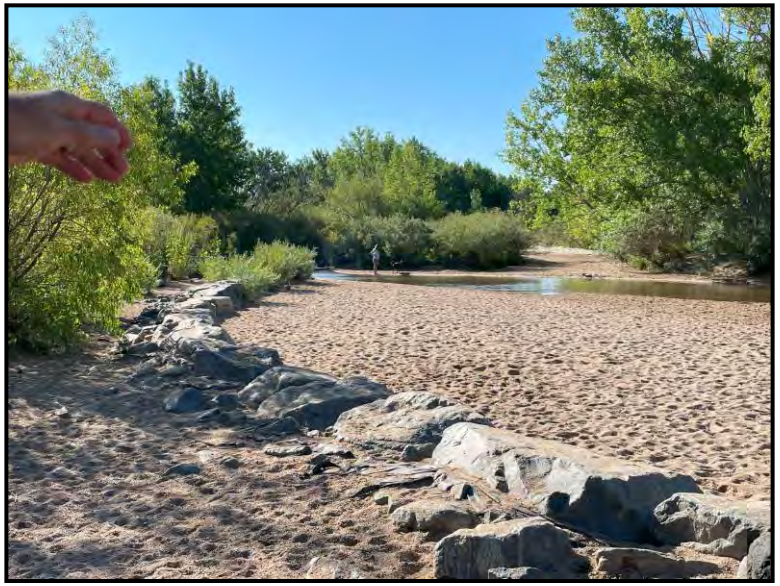

Photo 24.

Photographs taken by Wright Water Engineers, Inc.

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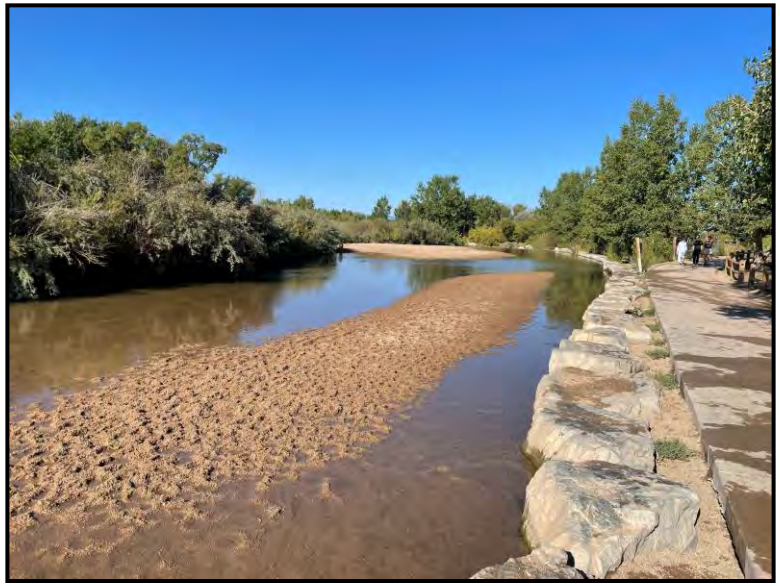

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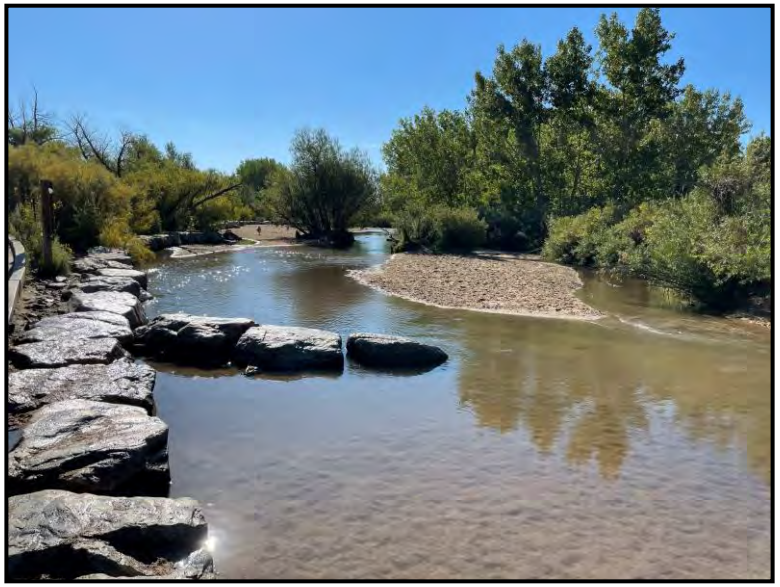

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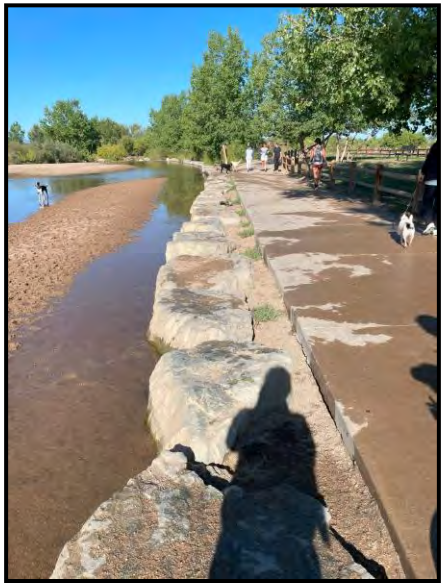

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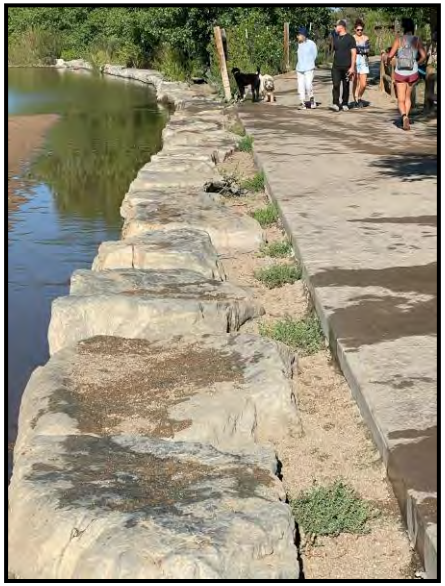

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Photographs taken by Wright Water Engineers, Inc.

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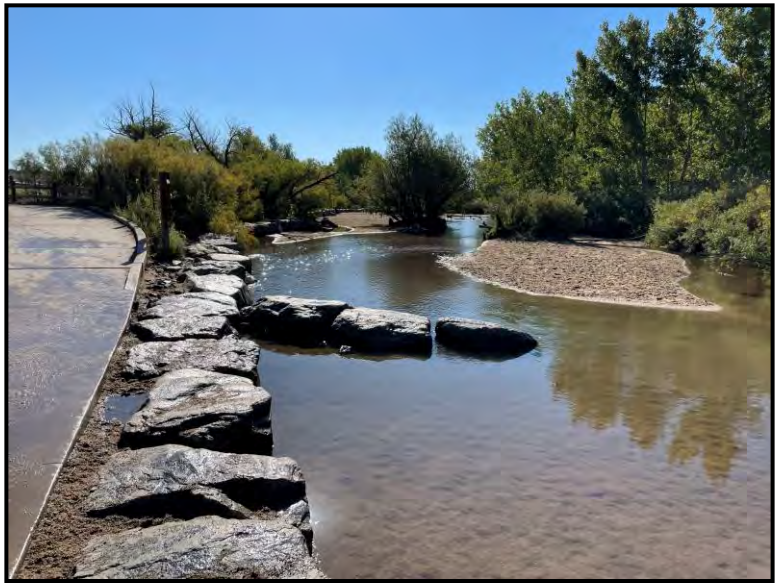

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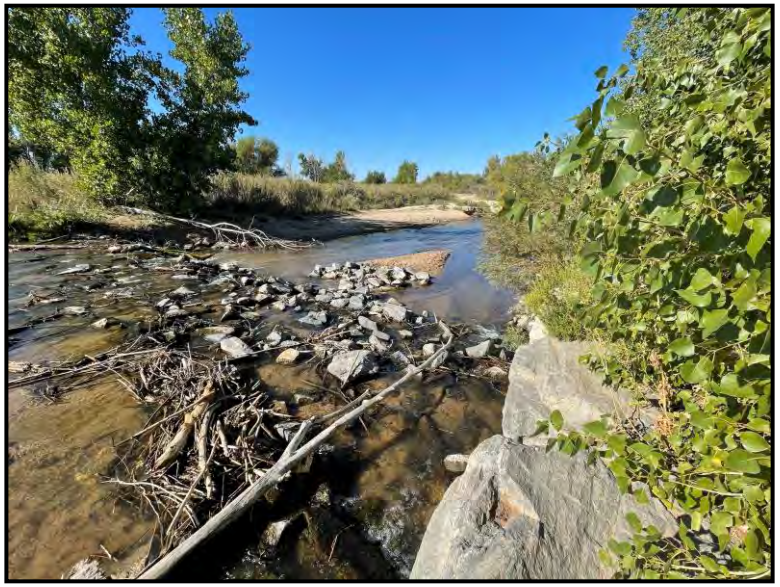

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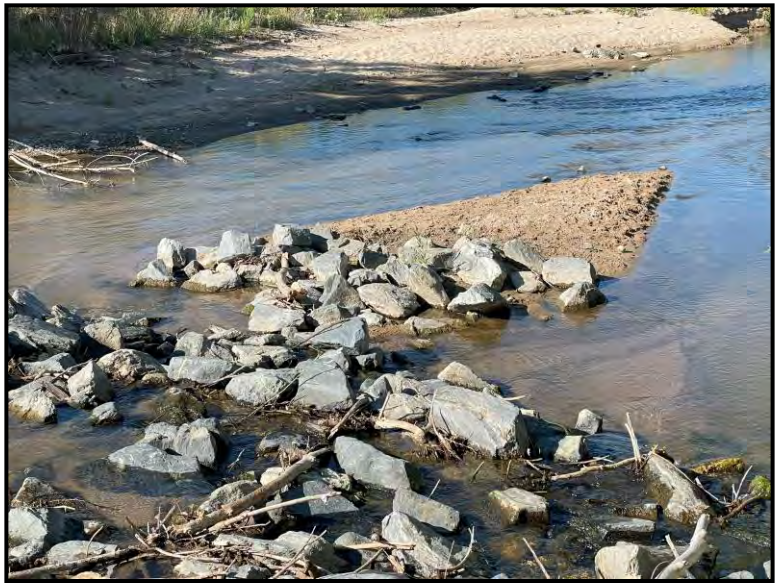

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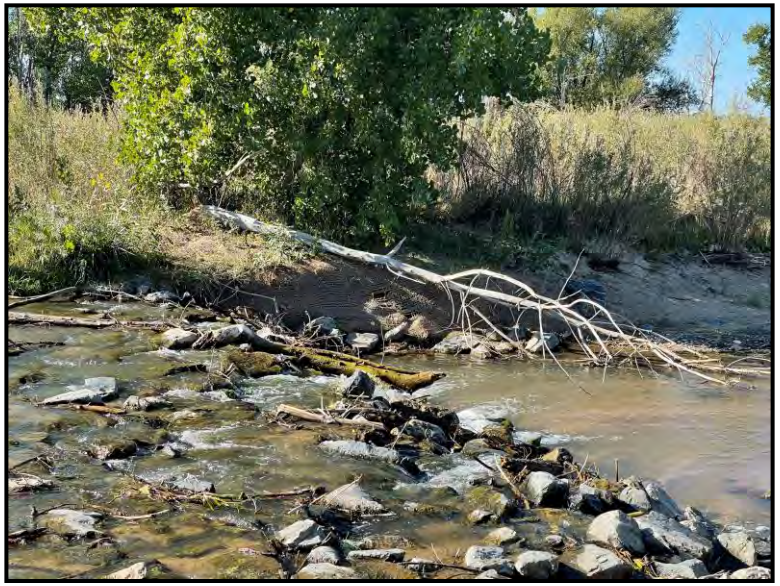

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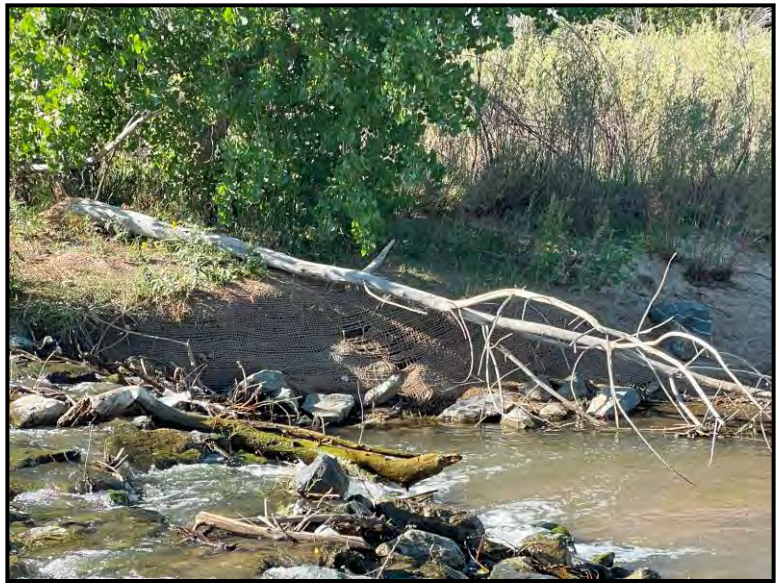
Photographs taken by Wright Water Engineers, Inc.

Appendix A: Photographs from August 27, 2024 Site Visit



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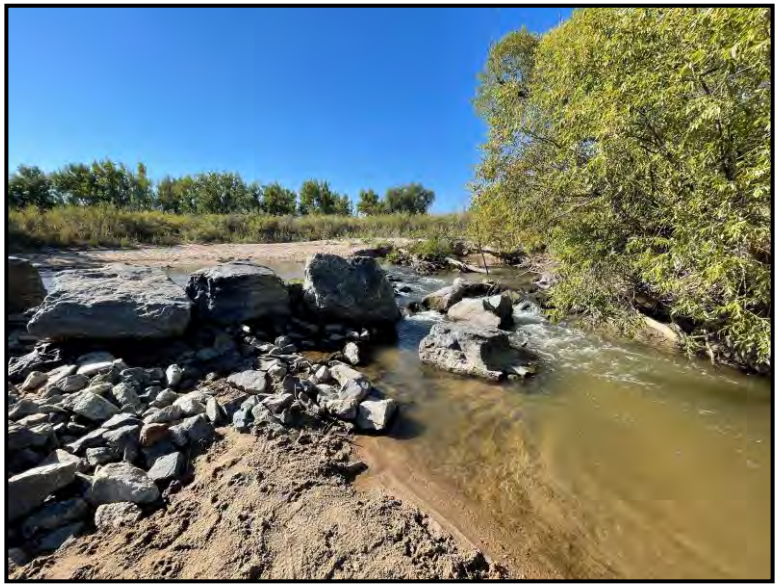

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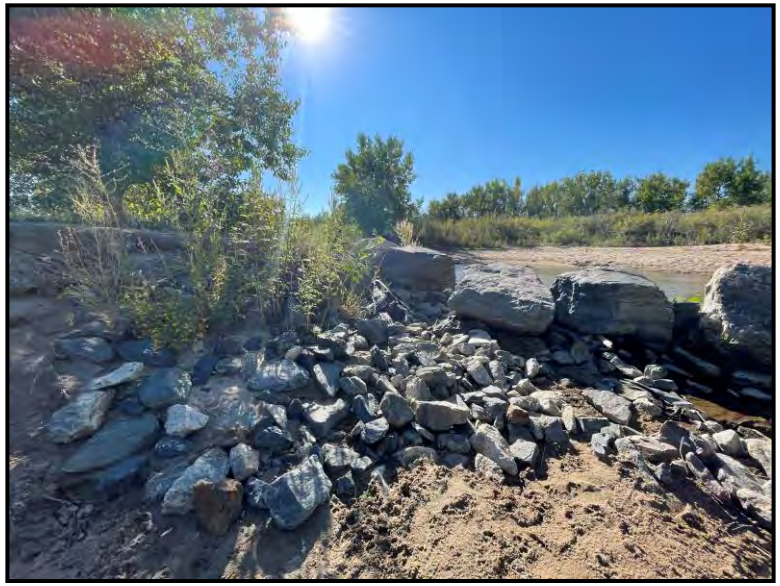

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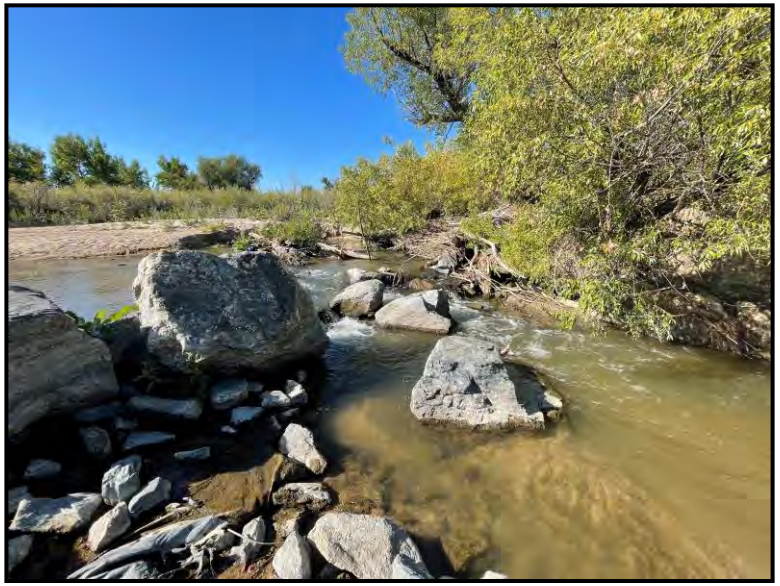

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Photographs taken by Wright Water Engineers, Inc.

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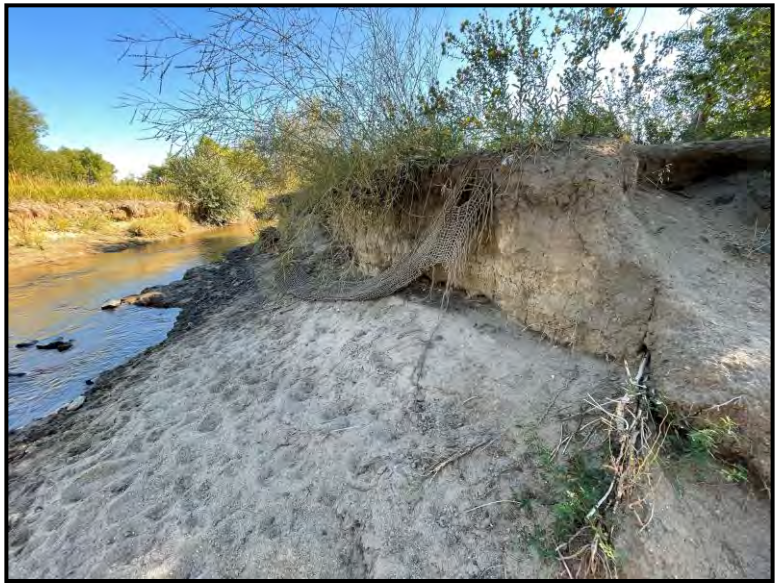

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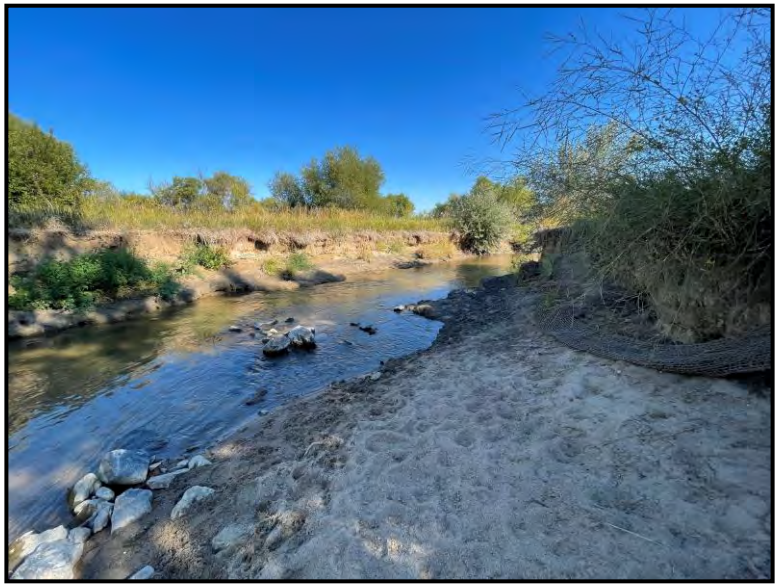

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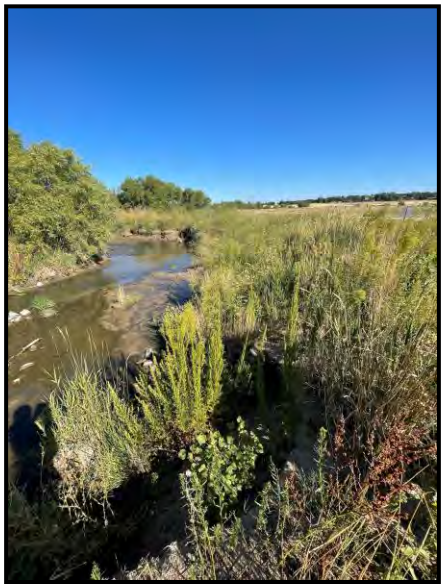

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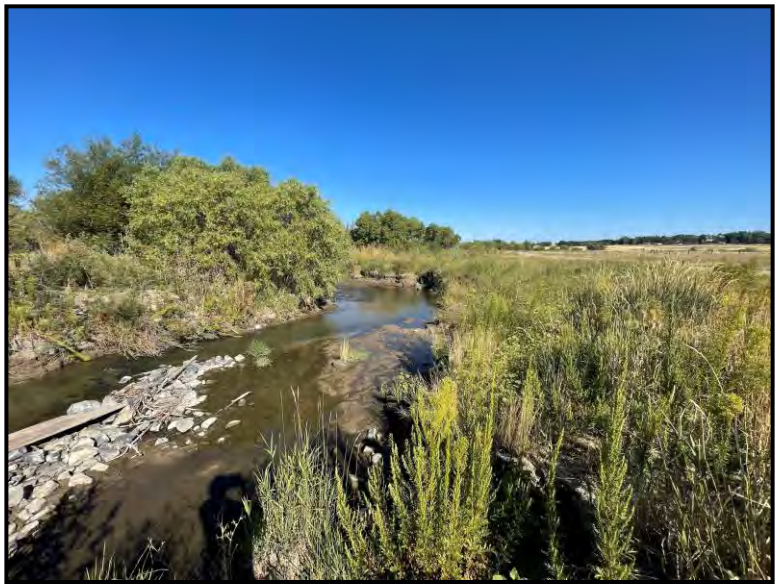

Photo 40.

Photographs taken by Wright Water Engineers, Inc.

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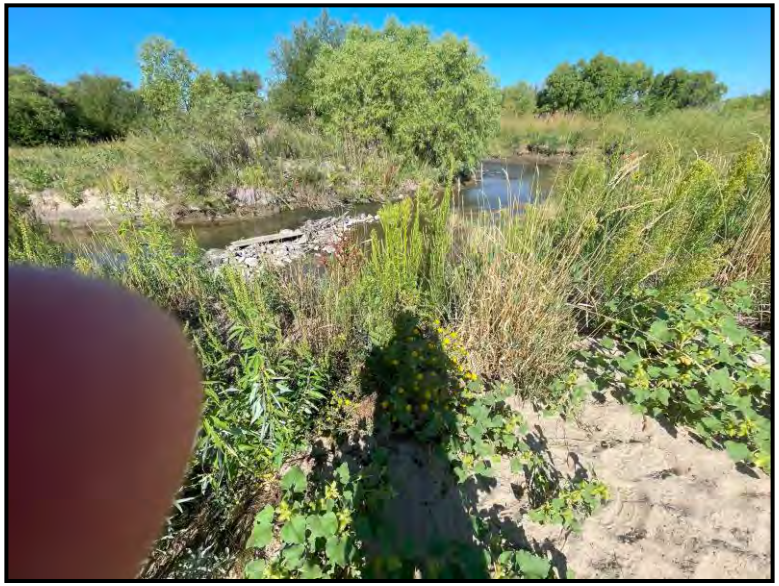

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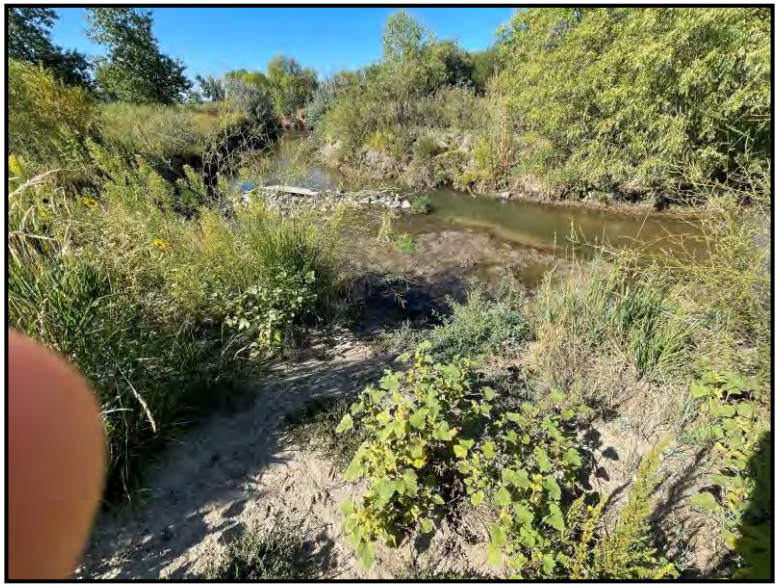

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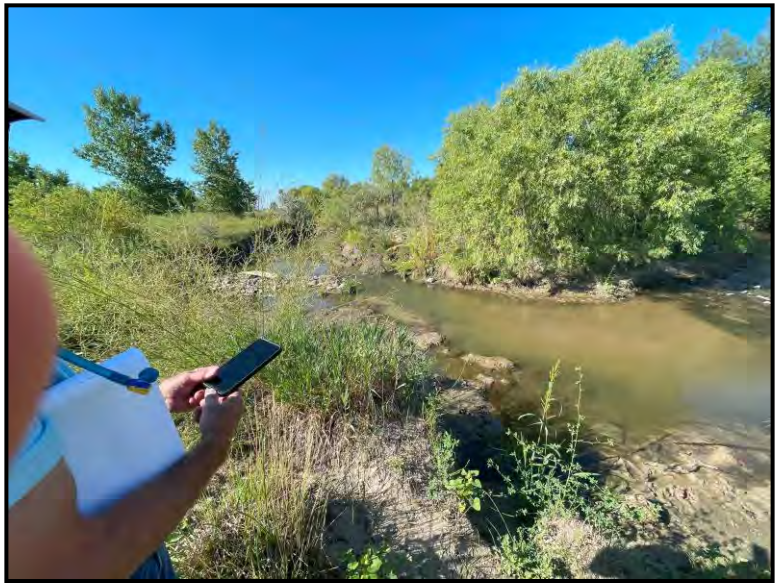

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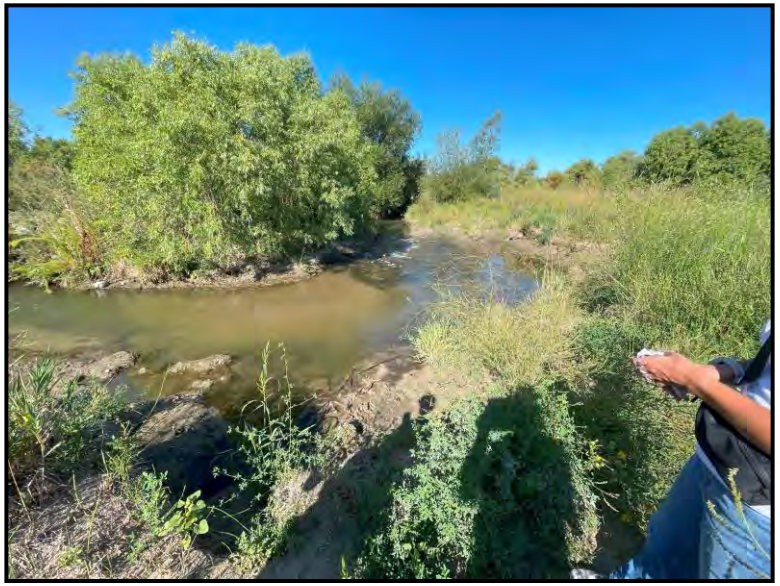

Photo 44.

Photographs taken by Wright Water Engineers, Inc.

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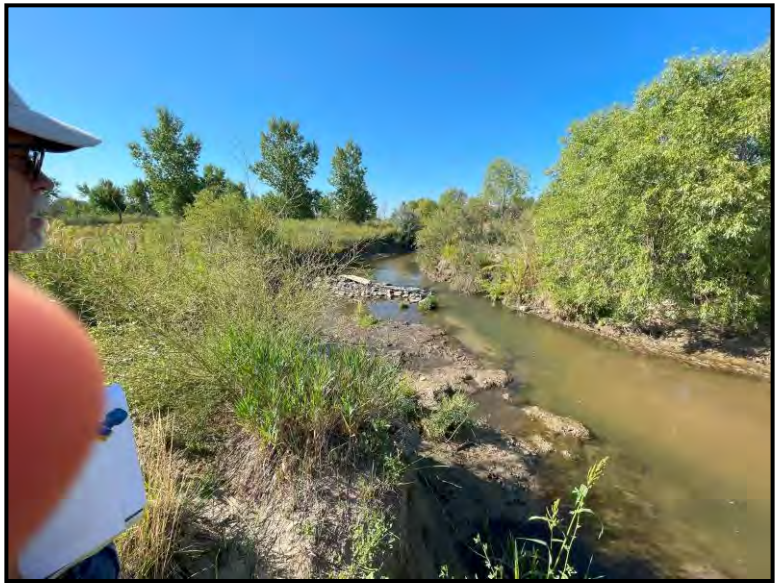

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