

# Cherry Creek Reach 1

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## 30% Design Memo

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**Prepared for:**

Cherry Creek Basin Water Quality Authority  
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## 1.1 Introduction

The purpose of this memo is to provide context for the 30% review of the Cherry Creek Reach 1 plans and cost estimate. A detailed design report will be provided as part of the 60% submittal package. Brief descriptions of design decisions are provided in this memo; detailed calculations for the reference reach analysis, planform parameters, and initial hydraulics can be provided upon request.

## 1.2 Existing Conditions

Reach 1 of Cherry Creek, extending from Lakeview Drive to the Reservoir, is experiencing significant degradation along most of its length, resulting in increased phosphorus loading to Cherry Creek Reservoir, damage to existing infrastructure, heightened risk to Aurora water lines and Lakeview Drive Road, as well as dewatering and loss of function of the riparian corridor and surrounding wetlands. Detailed reports of the existing conditions of Reach 1 can be found in the Cherry Creek Reach 1 – Alternatives Analysis Report by Muller Engineering, 2024.

## 1.3 Proposed Improvements

### 1.3.1 Geomorphology and Channel Layout

A reference reach analysis was conducted to inform the cross sectional, plan and profile layout of the primary channel through Reach 1. Multiple high functioning locations along Cherry Creek upstream of the reservoir were analyzed.

Bankfull depth of the primary channel is shown to range between 2.5' – 3', bankfull width ranges between 35' – 40', and bankfull flowrate is estimated to be approximately 170 cfs.

Planview parameters from the reference reach analysis were scaled to the Reach 1 site based on bankfull width and used to inform the layout. **Table 1** summarizes the ranges of these parameters. These ranges were used to guide the 30% design along with consideration of topography and vegetation.

**Table 1** - Reach 1 Planview Parameter Summary

Parameter	Range (ft)
Meander Wavelength	180 – 280
Linear Wavelength	160 – 250
Pool to Pool Spacing	80 - 180
Curve Radius	45 – 115
Belt Width	50 - 130

The profile of the primary channel was developed by lowering the overbank profile by 3' to 3.5'. The average valley slope for the project is approximately 0.5%, with sub reaches ranging from 0.1% to 0.8%. Slopes of rock riffle grade control structures, generally located at crossovers between outside bends based on the pool-to-pool spacing above, range from roughly 0.5% to 2%, with steeper riffles generally located in the steeper sub reaches, and vice-versa.

The goal of the primary channel design is to fill the deep eroding channel and create a shallower, stable conveyance for an appropriate range of Cherry Creek flows and sediment while restoring the creek's connection to its adjacent wide floodplain. This closer connection with its floodplain will improve the health of the riparian corridor and enable higher flows to spread out to be slowed, filtered, and infiltrated to further benefit water quality.

The operating pool elevation of Cherry Creek Reservoir is roughly 5550 but has experienced a range from approximately 5545 to 5559 and beyond. The channel improvements at the downstream tie-in extend to elevation 5545 to protect against channel erosion and potential undermining of the grade control structures when the reservoir is at low-pool elevation.

As the design of the channel progresses into a 60% level with a new detailed topographic survey and a focus on sediment transport analyses, it is expected that refinements to the cross section, plan and profile layout will be necessary to best meet the goals of the project.

### 1.3.2 Lakeview Drive

The Lakeview Drive crossing is proposed as a 20' span x 3' rise concrete box culvert (CBC) in addition to 14 existing 36" and 42" elliptical culverts in the ultimate condition. Flow control structures will be added to several of the existing culverts to ensure that flow events smaller than the bankfull event will be routed through the CBC into the primary channel. The existing culverts will convey flow under Lakeview Drive in events larger than the bankfull event. Flows from most of these culverts will be routed to the existing overbank flow paths downstream of Lakeview Drive.

If project funding for the Lakeview Drive CBC cannot be secured, an interim condition layout will be required. This layout will utilize the existing culverts, with no improvements to the overtopping capacity of Lakeview Drive being made. To route bankfull and smaller events under Lakeview Drive to the primary channel, a collector channel immediately downstream of the roadway will need to be constructed. This collector channel will convey the bankfull event to the primary channel and allow flows larger than this to spill onto the overbank towards the existing overbank flow paths.

30 percent design is not showing replacement of CMP culverts with RCP culverts due to concerns expressed with available funding; however, replacement of existing culverts with RCP is anticipated to reduce the risk of future failures, increase the life span, and facilitate maintenance and removal of debris.

### 1.3.3 Grade Control and Bank Protection

As mentioned, grade control structures along the primary channel of Reach 1 will consist of loose rock riffles constructed with void-filled riprap (VFR). Longitudinal slopes of these structures will range from <0.5% to- 2%, with drop heights of 0.5' to 1.0'. Riprap anchored log drop structures are proposed in low-risk areas and will be bracketed by standard VFR riffles both upstream and downstream. Due to the steep grade of Shop Creek at the confluence with Cherry Creek, grade control structures within the limits of the Shop Creek improvements will be loose rock boulder cascade structures constructed with boulders and VFR. Longitudinal slopes of these structures will be approximately 6% with drop heights of 1.6'.

Bank protection will be used in both the primary channel and Shop Creek and will consist of bioengineering methods such as large woody material, soil riprap, willow stakes, wetland plugs, and coir erosion control

blanket. Large woody material used in the bank protection and log drop structures will be re-purposed from trees that need to be removed due to the channel improvements.

### 1.3.4 Trail Crossings

Based on input from Colorado Parks and Wildlife (CPW), two trail crossings are shown along Reach 1, one at the Pipeline Trail crossing, and one at the Northern Connector Trail crossing. These crossings are envisioned as 100' +/- span pedestrian bridges. Beaver activity is expected throughout Reach 1, particularly at the crests of riffles. Hence, bridges will be located to cross the channel near the middle of drop structures to reduce the risk of flow blockage from beaver dams.

The Northern Connector trail crossing is likely to be constructed before the rest of the Reach 1 improvements due to time limits associated with CPW funding for the bridge. Layout of the bridge will be designed to function in both the existing and final conditions of its location.

### 1.3.5 Overbank Stabilization

Above the bankfull flowrate, there will be flow through the overbank flow paths in Reach 1. Targeted improvements are needed to stabilize areas prone to erosion. The goal is for these to consist of "softer" improvements instead of hardened structures and will consist of bioengineering methods such as woody material, willow thickets, wetland plugs, and coir erosion control blanket installed in areas of high shear stress to stabilize the surrounding soil and vegetation.

## 1.4 Opinion of Probable Cost

A 30% level engineers' opinion of probable construction costs (EOPCC) has been produced for two scenarios. The first is the ultimate condition, which assumes full funding for the Lakeview Drive CBC can be secured. The second is the interim condition, which assumes funding for the Lakeview Drive CBC is not able to be immediately secured, in which case the collector channel must be constructed. A detailed breakdown of these costs is included in this submittal package and a summary of these costs is shown below in Table 2 in comparison to Alternative 2A probable costs shown in the earlier alternatives report.

	Alternative 2A	Ultimate Condition	Interim Condition
Base Project: Primary Channel, Shop Creek, and Overbank Stabilization	\$7,820,000	\$6,570,650	\$6,794,650
Lakeview Drive	\$2,186,175	\$1,227,650	\$0
20% Construction Contingency and Construction Engineering Services	\$3,752,316	\$2,308,297	\$2,011,216
<b>Total Project Cost Opinion</b> <i>(Rounded up to nearest \$10k)</i>	<b>\$13,760,000</b>	<b>\$10,110,000</b>	<b>\$8,810,000</b>

The items below provide additional context and background on the 30% cost opinion.

1. The total costs are shown in 2024 dollars, inflated costs for 2025 and 2026 are presented in the detailed cost estimates.
2. Total project cost opinion includes a 20% construction contingency to account for the 30% level of design allowing for potential changes to the design that may affect costs.
3. The more detailed layout at 30% compared to the Alternative 2 layout resulted in a decrease of the total project cost. This decrease is primarily the result of reducing our assumptions regarding the number of locations and the magnitude of overbank stabilization west of the proposed primary channel. Additionally, a lower probable cost of the Lakeview Drive Improvements is shown due to a reduced scale of improvements compared to the assumptions during the alternatives phase. On the other hand, the length of the channel improvements and quantities for several channel stabilization items increased slightly over the alternatives layout resulting in an increased probable cost for channel improvements compared to the earlier estimate. Reductions in quantities and associated costs from the alternatives stage outweigh increases in probable costs at this level of design.
4. This 30% opinion of probable costs will be adjusted in subsequent stages as the design is advanced and refined based on updated detailed topographic surveys, hydraulic and sediment transport analyses, and implementation of strategies for mitigation of beaver activity, among other things. In addition, discussions with the Basin Authority and stakeholders will be ongoing regarding the desired level of protection associated with the improvements versus risk -- and balancing the level of protection against the available funding for the project.

Cost Estimate - ULTIMATE CONDITION						
BID ITEM #	DESCRIPTION OF BID ITEM	QUANTITY	PAY UNIT	UNIT PRICE	TOTAL COST OF BID ITEM	COMMENTS
<b>Base Project -- Primary Channel, Shop Creek, and Overbank Improvements</b>						
1	Clearing and Grubbing	37.3	AC	\$ 5,000.00	\$ 186,500	Includes removal of trees and wasting fallen trees in existing channel fill
2	Mobilization	1	LS	\$ 330,000.00	\$ 330,000	
3	Construction Survey	1	LS	\$ 85,000.00	\$ 85,000	
4	Traffic Control	1	LS	\$ 25,000.00	\$ 25,000	
5	Water Control	1	LS	\$ 200,000.00	\$ 200,000	
6	Rock Check Dam	2	EA	\$ 5,000.00	\$ 10,000	
7	Concrete Washout Area	1	EA	\$ 2,000.00	\$ 2,000	
8	Sediment Control Log	3700	LF	\$ 6.00	\$ 22,200	
9	Vehicle Tracking Control	4	EA	\$ 7,000.00	\$ 28,000	
10	Construction Fence, Orange Plastic	2000	LF	\$ 4.00	\$ 8,000	
11	Construction Fence, Rope with T-post	7500	LF	\$ 2.00	\$ 15,000	
12	Stream Crossing, Temporary, with Culvert	2	EA	\$ 15,000.00	\$ 30,000	
13	Access Roads	7300	SY	\$ 10.00	\$ 73,000	Construction and maintenance of temporary haul road
14	Stabilized Staging Area	3200	SY	\$ 15.00	\$ 48,000	
15	Earthwork, Excavation and Fill On-site	35600	CY	\$ 13.00	\$ 462,800	Assumes 15% shrinkage
16	Earthwork, Haul off site	3100	CY	\$ 35.00	\$ 108,500	Excess material to be hauled off site
17	Muck Excavation	1000	CY	\$ 110.00	\$ 110,000	
18	Topsoil, Excavate, Stockpile, Replace	28500	CY	\$ 18.00	\$ 513,000	
19	Boulder Cascades (Shop Creek)	450	SY	\$ 250.00	\$ 112,500	
20	Type M Void-Filled Riprap (Primary Channel Riffles)	6400	CY	\$ 150.00	\$ 960,000	
21	Type H Void-Filled Riprap (Primary Channel Riffles)	440	CY	\$ 150.00	\$ 66,000	
22	Type M Soil Riprap (Bank Protection, Primary Channel)	1950	CY	\$ 125.00	\$ 243,750	Assumes 50% of channel bends will not receive riprap BP
23	Type M Soil Riprap (Bank Protection, Shop Creek)	110	CY	\$ 125.00	\$ 13,750	
24	Beaver Mitigation	1	LS	\$ 200,000.00	\$ 200,000	Item to help reduce floodplain damage from beaver dam end-arounds
25	Beaver Dam Analogs	13	EA	\$ 10,000.00	\$ 130,000	
26	Pedestrian Trail Crossing	1	EA	\$ 175,000.00	\$ 175,000	Includes soft surface trail tie ins
27	Sheet Pile - Aurora Waterline	4530	SF	\$ 60.00	\$ 271,800	
28	Aurora Waterline Shallow Cover Protection (Concrete Saddles and/or Riprap)	1	LS	\$ 50,000.00	\$ 50,000	
29	Remove asphalt trail	1200	SY	\$ 27.00	\$ 32,400	
30	Large Wood Material	340	EA	\$ 250.00	\$ 85,000	For use in log drops, bank protection, overbank wood.
31	Erosion Control Blanket, Coir with Hand Shaken Mulch	47800	SY	\$ 13.00	\$ 621,400	75% of floodplain bench to be covered by coir
32	Mulch, Hydromulch (Outside of Erosion Control Blanket)	25.5	AC	\$ 3,500.00	\$ 89,250	
33	Plug, Wetland	60000	EA	\$ 5.00	\$ 300,000	Includes plugs on channel banks and wetland benches
34	Seeding, Upland, Broadcast	4.3	AC	\$ 4,000.00	\$ 17,200	Includes staging area and access not shown on plans
35	Seeding, Riparian, Broadcast	22.8	AC	\$ 5,000.00	\$ 114,000	
36	Seeding, Wetland, Broadcast	8.2	AC	\$ 6,000.00	\$ 49,200	
37	Willow Stakes	4800	EA	\$ 13.00	\$ 62,400	
38	Shrub/Tree Plantings/Willow Thicket Plantings	40	AC	\$ 18,000.00	\$ 720,000	
<b>Base Project -- Primary Channel, Shop Creek, and Overbank Improvements Subtotal</b>					<b>\$ 6,570,650</b>	
<b>Lakeview Drive</b>						
39	Mobilization	1	LS	\$ 60,000.00	\$ 60,000	
	Construction Survey	1	LS	\$ 15,000.00	\$ 15,000	
	Traffic Control	1	LS	\$ 15,000.00	\$ 15,000	
	Water Control	1	LS	\$ 50,000.00	\$ 50,000	
40	Rock Check Dam	1	EA	\$ 5,000.00	\$ 5,000	
41	Sediment Control Log	1300	LF	\$ 6.00	\$ 7,800	
42	Vehicle Tracking Control	1	EA	\$ 7,000.00	\$ 7,000	
43	Muck Excavation	300	CY	\$ 110.00	\$ 33,000	
44	Removal - Culvert #1	60	LF	\$ 30.00	\$ 1,800	
45	20' Span x 3' Rise Concrete Box Culvert	1	EA	\$ 300,000.00	\$ 300,000	
46	Boulder Cascade (CBC Entrance Structure)	190	SY	\$ 250.00	\$ 47,500	
47	Flow Control Structures	5	EA	\$ 25,000.00	\$ 125,000	
48	Flow Control Structures (Retrofit #2 and #5)	2	EA	\$ 5,000.00	\$ 10,000	
49	Type M Void-Filled Riprap (Culvert 2-8 Outfall Protection)	110	CY	\$ 150.00	\$ 16,500	
50	Type H Soil Riprap (Embankment Protection)	3000	CY	\$ 125.00	\$ 375,000	
51	Asphalt Removal	350	SY	\$ 27.00	\$ 9,450	
52	Asphalt Replacement	180	TON	\$ 220.00	\$ 39,600	
53	4" Water and 4" Sanitary Line Relocation	1	LS	\$ 110,000.00	\$ 110,000	
<b>Lakeview Drive Improvements Subtotal</b>					<b>\$ 1,227,650</b>	
<b>Ultimate Improvements Subtotal</b>					<b>\$ 7,798,300</b>	
<i>Contingency (20%)</i>					\$ 1,559,660	
<b>Ultimate Improvements Total Construction</b>					<b>\$ 9,357,960</b>	
<i>Construction Services (8%)</i>					\$ 748,637	
<b>Ultimate Improvements Total Cost (2024 Dollars)</b>					<b>\$ 10,110,000</b>	
<b>Ultimate Improvements Total Cost (2025 Dollars)</b>					<b>\$ 10,820,000</b>	Assuming 7% inflation
<b>Ultimate Improvements Total Cost (2026 Dollars)</b>					<b>\$ 11,580,000</b>	Assuming 7% inflation

CDOT CPI - Inflation		
2023 Q1	1.87	7.0%
2023 Q4	2.00	

Note: average annual inflation 2012-2023 is 7.8%

**Assumptions**

- 1 Earthwork calculations based upon LIDAR, may change when detailed survey is completed
- 2 Soil amendments may not be required and are not included in this estimate
- 3 A second pedestrian bridge trail crossing is planned and will be funded by CPW separately from this project; therefore, its costs are not included.

Cost Estimate - INTERIM CONDITION						
BID ITEM #	DESCRIPTION OF BID ITEM	QUANTITY	PAY UNIT	UNIT PRICE	TOTAL COST OF BID ITEM	COMMENTS
<b>Primary Channel and Shop Creek</b>						
1	Clearing and Grubbing	37.3	AC	\$ 5,000.00	\$ 186,500	Includes removal of trees and wasting fallen trees in existing channel fill
2	Mobilization	1	LS	\$ 330,000.00	\$ 330,000	
3	Construction Survey	1	LS	\$ 85,000.00	\$ 85,000	
4	Traffic Control	1	LS	\$ 25,000.00	\$ 25,000	
5	Water Control	1	LS	\$ 200,000.00	\$ 200,000	
6	Rock Check Dam	3	EA	\$ 5,000.00	\$ 15,000	
7	Concrete Washout Area	1	EA	\$ 2,000.00	\$ 2,000	
8	Sediment Control Log	3700	LF	\$ 6.00	\$ 22,200	
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12	Stream Crossing, Temporary, with Culvert	2	EA	\$ 15,000.00	\$ 30,000	
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21	Type H Void-Filled Riprap (Primary Channel Riffles)	440	CY	\$ 150.00	\$ 66,000	
22	Type H Void-Filled Riprap (Collector Channel)	1460	CY	\$ 150.00	\$ 219,000	
23	Type M Soil Riprap (Bank Protection, Primary Channel)	1950	CY	\$ 125.00	\$ 243,750	Assumes 50% of channel bends will not receive riprap BP
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38	Willow Stakes	4800	EA	\$ 13.00	\$ 62,400	
39	Shrub/Tree Plantings/Willow Thicket Plantings	40	AC	\$ 18,000.00	\$ 720,000	
<b>Primary Channel and Shop Creek Improvements Subtotal</b>					<b>\$ 6,794,650</b>	
Contingency (20%)					\$ 1,358,930	
<b>Interim Improvements Total Construction</b>					<b>\$ 8,153,580</b>	
Construction Services (8%)					\$ 652,286	
<b>Interim Improvements Total Cost (2024 Dollars)</b>					<b>\$ 8,810,000</b>	
<b>Interim Improvements Total Cost (2025 Dollars)</b>					<b>\$ 9,430,000</b>	Assuming 7% inflation
<b>Interim Improvements Total Cost (2026 Dollars)</b>					<b>\$ 10,100,000</b>	Assuming 7% inflation

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