

# Glenwood Canyon Recovery Concept

Response to Burn Scar Flooding, Mudslides, and Rockslides

06/25/21-08/02/21



In late July and early August, 2021 multiple debris flows in the Grizzly Creek Fire Burn Scar buried and damaged both decks of I-70 in numerous places through Glenwood Canyon. This resulted in a long-term closure of the interstate. Debris and flood flows also damaged the Union Pacific rail line and an Xcel power line in the canyon.

The sediment deposited in the Colorado River is limiting flood conveyance and pushing the flow of the river against the highway or railroad in at least six places. This will result in further highway damage and severe impacts to travel if not mitigated before river flows increase with snowmelt in the spring of 2022.

Glenwood Canyon is a corridor that is shared by the interstate highway, recreational path, railroad, utilities, the Colorado River and all their users. The goal is to facilitate recovery in a way that addresses safety and the multiple uses and function of the Glenwood Canyon corridor.

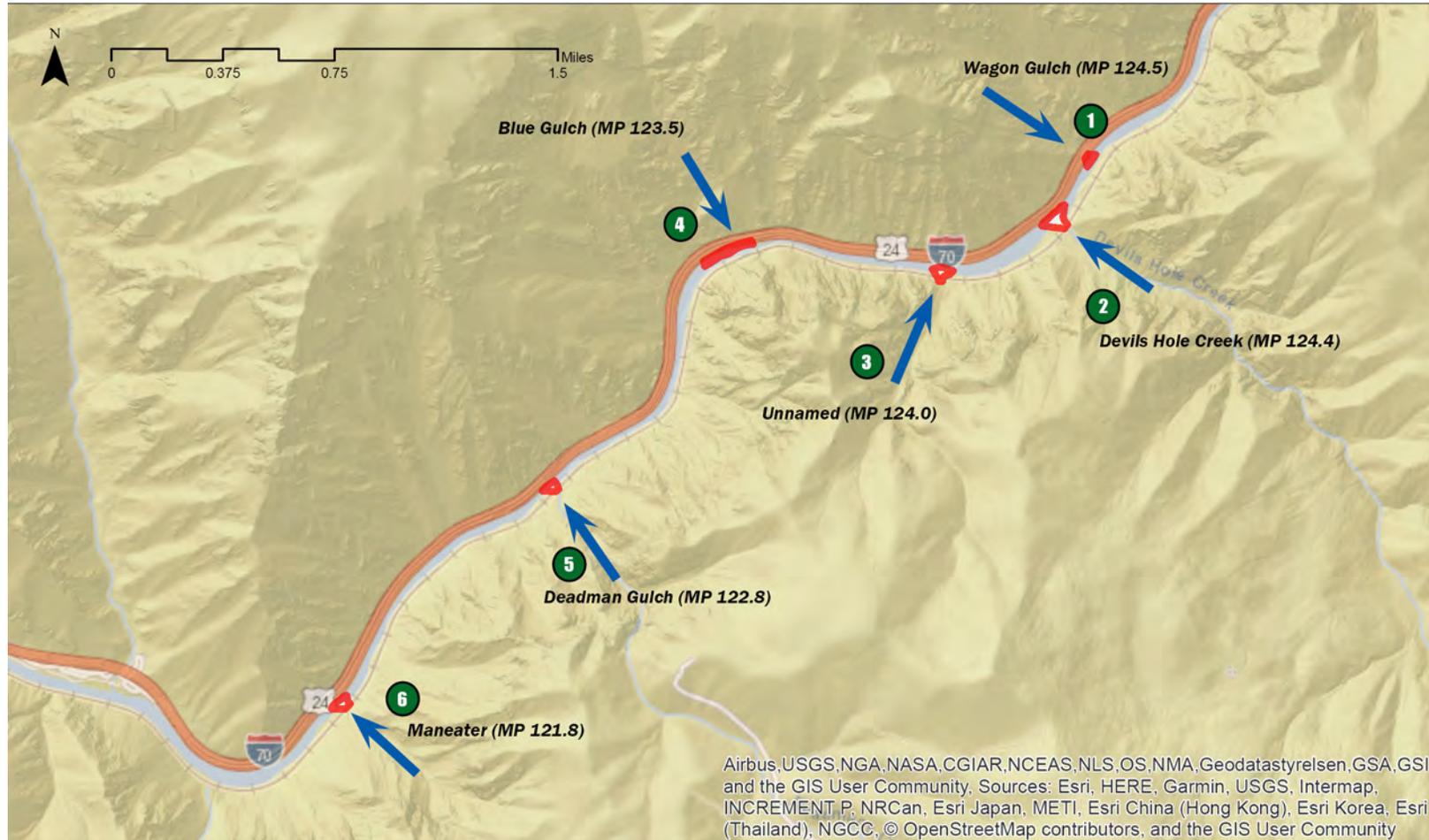
Submitted on August 30, 2021



Wagon Gulch (right) and Devil's Hole (left)

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## Event Description



In total, between July 20th and July 30th more than 3 inches of rain fell on the area burned by the Grizzly Creek fire. At times, the rainfall intensity exceeded 0.5 to 1.1 inches in 15 minutes.

This amount and intensity of precipitation falling on the impaired landscape resulted in six major debris/mud flows (areas of impact) in Glenwood Canyon. These locations are shown and named in the map to the left.

The estimated volume of material deposited in the Colorado River ranges from 90,000 to 160,000 cubic yards. Additional data needed to refine this estimate is currently being processed.

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## Response Outline

In August, the Colorado Department of Transportation removed nearly 8,000 tons of debris from the highway surfaces to reopen I-70 through Glenwood Canyon. The highway is currently open but closes to traffic when the National Weather Service issues Flash Flood Warnings for the burn scar.

The repair of damage to I-70 and associated highway infrastructure is being led by CDOT with funds initially provided by FHWA to cover a variety of costs related to repair, safety, planning, and administration.

The Union Pacific rail line and Xcel are removing sediment and repairing their infrastructure with their own funds.

The management and removal of the debris and sediment that is restricting and redirecting the flow of water in the Colorado River is not yet funded and this task is imperative to the continuation of safe corridor usage in 2022. Details on measures needed at each impacted area are included in the following pages. This document is to support the request for funding to address this component of the overall recovery plan.



# Glenwood Canyon Recovery Concept



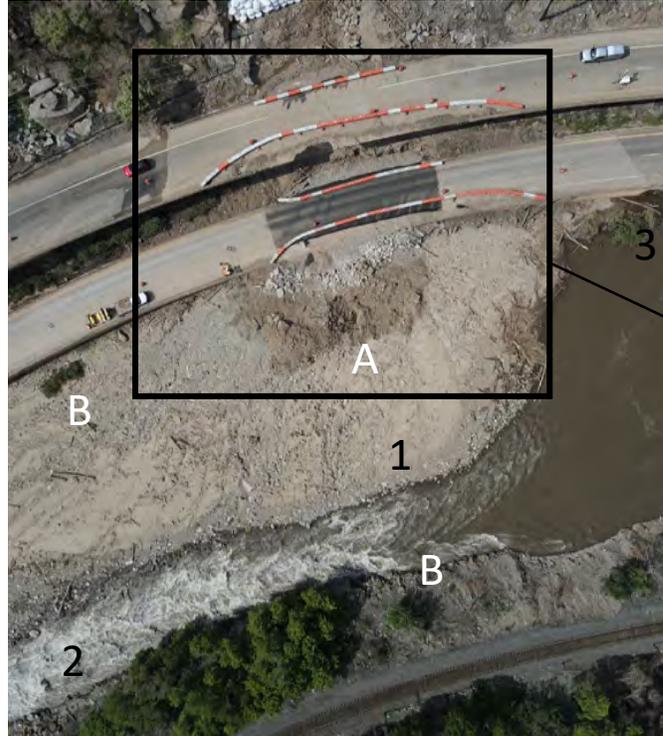
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## Priority #1: Blue Gulch (MP 123.5)

### Problem Statements

\*Numbering corresponds to the numbers shown in the photo

- 1) Sediment fan is severely constricting flow in the Colorado River.
- 2) The sediment is directing high energy flows at the railroad embankment and highway. This is likely causing scour and erosion of the highway's foundation and there are visual signs that the railroad embankment is beginning to fail due to this flow.
- 3) The sediment is causing a significant backup of water currently estimated to be between 5 and 10 feet.
- 4) There is sediment in the river that as high as the east bound lanes of I-70. This may result in flooding and highway closures when the river is swollen with snowmelt in the spring of 2022.
- 5) Broken and mobile trees pose a hazard to recreationalists and downstream infrastructure.



### Description of Work

\*Lettering corresponds to the letters shown in the photo

- |   |  |
|---|--|
| <p>A) Remove 80-100% of the sediment deposited in the Colorado River.</p> <p>B) Reshape river's bed and banks to direct high energy flows away from rail and highway embankments.</p> | <p>C) Remove mobile and broken trees.</p> <p>D) Protect recreational path and highway embankment with placed rock and other natural materials.</p> |
|---|--|

### Estimated Cost for Blue Gulch

\*Full project costs and quantity and cost assumptions can be found on pages 8 and 9.

\$9,400,000

### Estimated Sediment Removal

50,000 cubic yards

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## Priority #2: Devil's Hole (MP 124.4)

### Problem Statements

\*Numbering corresponds to the numbers shown in the photo

- 1) Sediment fan is severely constricting flow in the Colorado River.
- 2) The sediment is causing a significant backup of water that extends over half a mile upstream and is currently flooding the recreational path.
- 3) This impact on flow conveyance may result in flooding of the east bound lanes of I-70 when the river is swollen with snowmelt in the spring of 2022.
- 4) Additionally, the sediment has pushed high energy flows against the highway embankment which is likely causing scour and erosion of the highway's foundation.
- 5) Flows from the drainage are unable to drain to the river through the railroad bridge.
- 6) Broken and mobile trees pose a hazard to recreationalists and downstream infrastructure.



### Description of Work

\*Lettering corresponds to the letters shown in the photo

- |   |   |
|---|---|
| A) Remove 60-90% of the sediment deposited in the Colorado River.               | D) Restore river to maintain recreational and ecological uses.                                    |
| B) Improve drainage pathways from the Devil's Hole Creek to the Colorado River. | E) Protect recreational path and highway embankment with placed rock and other natural materials. |
| C) Remove mobile and broken trees.  |   |

### Estimated Cost for Devil's Hole

\*Full project costs and quantity and cost assumptions can be found on pages 8 and 9.

\$4,600,000

### Estimated Sediment Removal

25,000 cubic yards

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## Priority #3: Unnamed (MP124.0)



### Problem Statements

\*Numbering corresponds to the numbers shown in the photo

- 1) There is a significant quantity of sediment sitting in the drainage that may fully block the river if mobilized in another rain event.
- 2) Sediment in the river is pushing flow against the highway embankment.
- 3) Sediment in the river is restricting flows and currently flooding the recreational path.



### Description of Work

\*Lettering corresponds to the letters shown in the photo

- |   |   |
|---|---|
| A) Remove and stabilize sediment in the drainage to the Colorado River. | C) Restore river to maintain recreational and ecological uses.                                    |
| B) Remove 30-60% of the sediment deposited in the Colorado River.       | D) Protect recreational path and highway embankment with placed rock and other natural materials. |

### Estimated Cost for Unnamed

\*Full project costs and quantity and cost assumptions can be found on pages 8 and 9.

\$5,200,000

### Estimated Sediment Removal

28,000 cubic yards

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Secondary Priorities: Maneater (MP 121.8), Deadman Gulch (MP 122.8) and Wagon Gulch (MP 124.5),



**Maneater MP 121.8**

Opportunity to regrade approximately half the material onsite (approximately 5,600 cubic yards) to reduce pressure on highway and redirect flows away from rail line. It's possible to let the river do some of the work to move and stabilize the remainder of the sediment (with or without artificial pulse flows).

**Estimated Cost for Maneater**

\$550,000



**Deadman Gulch MP 122.8**

Opportunity to remove or regrade approximately 25-50% of the deposited sediment (approximately 2,800 cubic yards) to reduce impact to the recreational path and highway piers during larger flows. It's possible to let the river do some of the remaining work of reshaping the sediment.

**Estimated Cost for Deadman**

\$350,000



**Wagon Gulch MP 124.5**

Opportunity to clear the recreational path and allow the river reorganize the remainder of the sediment. This area is primarily impacted by the Devil's Hole sediment deposit rather than the Wagon Gulch sediment deposit. Estimated sediment removal of 2,100 cubic yards.

**Estimated Cost for Wagon Gulch**

\$400,000

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## Response Outline: Major Cost and Project Assumptions



### Estimated Quantity of Sediment Deposited in the Colorado River

The volume of sediment in the river was estimated by determining using the area of the sediment fields using photos and aerial imagery and an average depth based on field observations. Estimates were provided by 3 separate organizations, and all were similar.

This number will be refined when the post-event photogrammetry is processed. We can then use this elevation data and the pre-event elevations from a previous LiDAR survey to determine the amount of sediment that has entered into the river corridor.



Devil's Hole

### Estimated Quantity of Sediment to Remove from the Colorado River

These quantities are based on professional judgement by engineers and geologists with considerations of flow conveyance (how much water needs to move through the river at that location) and flow energy (will the water be able to move this sediment on its own).

This number will be refined when the computer modeling to determine the ground shaping necessary to safely accommodate flood flows is completed by CDOT.

### Cost of Sediment and Debris Removal

This unit cost is based on engineering judgement and recent charges on other projects with similar work items. It assumes a 1 to 1.5 hour haul distance (one-way) and that removing the sediment from the corridor and placing it in its final location will require handling by three to five separate pieces of equipment.

Haul will likely need to occur on both the highway and on the rail line.

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## Response Outline: Estimated Project Costs



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| Item No.   | CDOT Specification Division | Line Item   | Unit | Quantity | Engineer's Estimate |                   |
|--|-----------------------------|---|------|----------|---------------------|-------------------|
|  |                             |   |      |          | Unit Cost           | Total             |
| <b>BASE BID</b>  |                             |   |      |          |                     |                   |
| <b>Task 1: General and Grading</b>                       |                             |   |      |          |                     |                   |
| 1.1  | 100                         | <b>Mobilization</b>   |      |          |                     |                   |
|  |                             | <i>Mobilization, \$50,000 for bio-fluid; 3% for mobilization</i>                                      | LS   | 1        | \$ 650,000          | \$ 650,000        |
| 1.2  | 100                         | <b>Erosion Control</b>  |      |          |                     |                   |
|  |                             | <i>Erosion and Sediment Control at Project Location</i>   | LS   | 1        | \$ 75,000           | \$ 75,000         |
| 1.3  | 600                         | <b>Construction Surveying</b>   |      |          |                     |                   |
|  |                             | <i>Construction Surveying (Utility Coordination &amp; Staking &amp; As-Builts)</i>                    | LS   | 1        | \$ 60,000           | \$ 60,000         |
| 1.4  | 100                         | <b>Dewatering/Water Control</b>   |      |          |                     |                   |
|  |                             | <i>Dewatering/Water Control</i>   | LS   | 1        | \$ 250,000          | \$ 250,000        |
| 1.5  | 200                         | <b>Traffic Control (Special)</b>  |      |          |                     |                   |
|  |                             | <i>Traffic Control (Special)</i>  | MO   | 6        | \$ 200,000          | \$ 1,200,000      |
| 1.6  | 200                         | <b>Excavation and Embankment</b>  |      |          |                     |                   |
|  |                             | <i>Unclassified Excavation-With Export of Excess Material</i>   | CY   | 105000   | \$ 150              | \$ 15,750,000     |
|  |                             | <i>Unclassified Excavation-Complete in Place</i>  | CY   | 10000    | \$ 40               | \$ 400,000        |
|  | Special Revison             | <i>Unclassified Excavation-Fine Grading, Bank, and Bed Shaping</i>                                    | LF   | 3000     | \$ 400              | \$ 1,200,000      |
| <b>Task 2: Stabilization and Debris Management</b>       |                             |   |      |          |                     |                   |
| 2.1  | Special Revison             | <b>Downstream Debris Management</b>   |      |          |                     |                   |
|  |                             | <i>Debris Catchers at Downstream Water Intakes</i>  | EA   | 5        | \$ 125,000          | \$ 625,000        |
| 2.2  | 700                         | <b>Riprap</b>   |      |          |                     |                   |
|  |                             | <i>Riprap and Scour Protection</i>  | CY   | 2500     | \$ 80               | \$ 200,000        |
| <b>Task 3: General Site Rehabilitation</b>               |                             |   |      |          |                     |                   |
| 3.1  | 200                         | <b>General Site Restoration</b>   |      |          |                     |                   |
|  |                             | <i>Seeding, Mulching, Plantings and General Site Restoration to Specifications at sediment fields</i> | LS   | 3        | \$ 20,000           | \$ 60,000         |
|  |                             | <i>Seeding, Mulching, Erosion Control, General Site Restoration at disposal location</i>              | LS   | 1        | \$ 750,000          | \$ 750,000        |
| <b>Construction Subtotal</b>                             |                             |   |      |          | <b>\$</b>           | <b>21,220,000</b> |
| <b>Task 4: Data Collection and Professional Services</b> |                             |   |      |          |                     |                   |
| 4.1  | n/a                         | <b>Technical Services</b>   |      |          |                     |                   |
|  |                             | <i>Engineering and Permitting Assumed at 5% of Construction costs</i>                                 | LS   | 1        | \$ 1,000,000        | \$ 1,000,000      |
|  |                             | <i>Construction Management at 10% of Construction costs</i>   | LS   | 1        | \$ 2,000,000        | \$ 2,000,000      |
| <b>Estimated Total Project Cost</b>                      |                             |   |      |          | <b>\$</b>           | <b>24,220,000</b> |