CDOT R1 I-70 WB BAKERVILLE TO EJMT CLIMBING LANE EXISTING CONDITIONS REPORT

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Prepared for:

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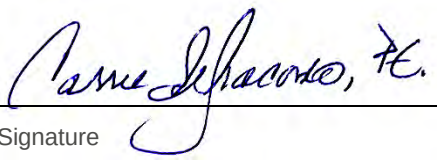
REVISION HISTORY

Revision	Date	Description
Draft	10/6/2022	Draft Report for Client Review
Draft	11/18/2022	Draft Report for Client Review
Final	12/7/2022	Final Report for Client Use

PROFESSIONAL ENGINEER

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Colorado.



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5/19/2023

Date

Number

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ACRONYMS AND ABBREVIATIONS

%	Percent
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
AADT	Average Annual Daily Traffic
ATR	Automatic Traffic Recorder
BMPs	Best Management Practices
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CDT	Continental Divide Trail
CSGC	Concrete Slab and Girder Continuous (Poured in Place)
CWA	Clean Water Act
DRCOG	Denver Regional Council of Governments
EB	Eastbound
EJMT	Eisenhower Johnson Memorial Tunnel
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
I-70	Interstate 70
ITS	Intelligent Transportation System
mi2	square miles
MP	Mile post
mph	miles per hour
NFIP	National Flood Insurance Program
NRCS	Natural Resources Conservation Service
OTIS	Online Transportation Information System
RockSol	RockSol Consulting Group, Inc.
ROW	Right-of-way
SCAP	Sediment Control Action Plan
SSA	Storm and Sanitary Analysis
UDFCD	Urban Drainage and Flood Control District
Ulteig	Ulteig Engineers, Inc.
US	United States
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USGS	United States Geological Survey
VMS	Variable Message Sign
vpd	Vehicles per day
VSL	Variable Speed Limit
WB	Westbound
WG	Welded Girder
WGCK	Welded Girder Continuous and Composite
WOUS	Waters of the United States

1 INTRODUCTION

The Colorado Department of Transportation (CDOT) is investigating the addition of a westbound (WB) climbing lane along Interstate 70 (I-70) in a section of high traffic volumes and steep grades in the mountain corridor to address existing operational challenges and safety issues. The proposed climbing lane stretches approximately from WB milepost (MP) 215.3 at the entrance of the Eisenhower Johnson Memorial Tunnel (EJMT) to MP 221.3 which represents the Bakerville interchange in Clear Creek County.

This project entails the following items on westbound I-70 with emphasis on minimizing impacts to stakeholders and the traveling public:

- Addition of a climbing lane for the full length of the project
- Evaluation and accommodation of two existing chain stations, and associated utility work
- Rock excavation
- Reconstruction and/or widening of two bridges to accommodate the climbing lane
- Potential interchange realignment (at US6)
- Guardrail improvements
- Intelligent Transportation System (ITS) improvements
- Pavement resurfacing
- Signing and striping
- Utility improvements including fiber backbone relocation
- Water quality features
- Wildlife crossing

CDOT has identified these improvements as a high priority to address immediate congestion and safety issues.

1.1 Study Corridor Overview

The I-70 Westbound Bakerville to EJMT Climbing Lane project's study area includes westbound I-70 between MP 215.3 to MP 221.3. I-70 connects Colorado's front range with mountain communities, recreational areas, and resorts through the Rocky Mountains of Colorado. It is a major east-west travel corridor through the state of Colorado that includes large volumes of commercial and recreational traffic.

I-70 recreational traffic is highest on the weekends. Volumes on weekend afternoons throughout the year are regularly well over capacity, causing severe congestion throughout the corridor. Access to recreational trails exist off the Bakerville and Herman Gulch interchanges. The project area also includes the recreational access to the Loveland Ski Area provided off the US 6 interchange.

In addition to providing recreational travel, I-70 serves as a critical freight corridor in Colorado. I-70 is listed on the Primary Highway Freight System which is a network of highways representing the most critical portions of the United States freight transportation system. Heavy vehicles rely on the Corridor for movement of goods and materials from both the east and the west, as no alternative continuous routes exists within Colorado. EJMT sits at the highest elevation along I-70 and gets considerable snow and ice during the winter. The project limit starts at an elevation around 9760 feet at the Bakerville Interchange and travels to 11,013 feet at EJMT. Thus, the grades up to EJMT are steep and create challenging conditions for trucks and passenger cars in the steady climb to the tunnel. Speed differentials between heavy commercial freight and faster moving vehicles cause significant operational and safety challenges leading to significant delays and impeding emergency response times. Freight vehicles hauling hazardous material and trucks that exceed the EJMT height restriction must exit at the US 6 interchange (MP 216) as they are not permitted to travel through EJMT.

The Corridor lies within a high elevation mountain environment where wildlife is abundant. Vehicle and animal collisions are frequent and mitigation efforts will be considered in the project. In addition, I-70 is within the United States Forest Service (USFS) property and resides on an easement. Part of the Corridor travels through the Arapaho National Forest.

Figure 1. Project overview map

Numerous factors could cause full closure of I-70 in the project area, raising the risks of keeping the interstate open and functional. An avalanche and debris chute exists within the project limits and aging structures at Bakerville, Herman Gulch and US 6 interchanges exist. The resiliency of I-70 is critical in preserving:

- Movement of commercial freight for the state and for the country
- The only continual east – west interstate route across the state of Colorado
- Connection between the Front Range to western Colorado

1.2 Report Resources

This report provides a description of the existing engineering design elements (geometric design, structures, water resources, utilities, and bicycle and pedestrian access) within the study limits. This review was prepared to identify the current conditions of the roadway and surrounding areas to help identify deficiencies.

The following resources were used to analyze existing conditions and to identify planned facilities and design guidelines:

- Site Visits (August 24, 2022, September 14, 2022 and September 20, 2022)
- As-built plans and other project related data
- CDOT Drone video of existing project site conditions captured October 2021
- CDOT, Online Transportation Information System (OTIS)
- CDOT Traffic Safety Assessment Report on I-70 between MP 215.3 – MP 221.5 (January 2022)
- CDPHE, 303(d) List of Water-Quality-Limited Segments Requiring TMDLs – 303(d) List and Colorado's Monitoring and Evaluation List, 2022
- CDPHE, COR400000 CDPS General Permit Stormwater Discharges Associated with Construction Activity, January 2021
- Clear Creek Watershed Foundation, Upper Clear Creek Watershed Plan Update, April 2014

- FEMA, FIRM Panel for Clear Creek County, Colorado and Incorporated Areas, Map Number 08019C0175D, March 19, 2007
- FEMA, Flood Insurance Study for Clear Creek County, Colorado and Incorporated Areas FEMA FIS Number 08019CV000C, Revised December 20, 2019
- I-70 Mountain Corridor Aesthetics Guidance
- Interstate 70 Directional Safety Assessment Report: MP 215.30 to MP 221.50 Bakerville Interchange to Eisenhower Tunnel East Portal (Draft Report, September 2022)
- Linkage Interference Zone Report
- Matrix, I-70 Clear Creek Corridor Sediment Control Action Plan, September 2013
- USGS, StreamStats, September 2022

2 EXISTING GEOMETRIC CONDITIONS

This section documents the existing geometric conditions of the westbound I-70 roadway within the project limits. The existing geometric conditions have been obtained from corridor as-built plans, existing topography survey, 2011 LiDAR data, aerial imagery, and from information recorded at several site visits. The existing conditions and critical issues are presented in the following existing geometric conditions categories.

2.1 Existing Design Speed

The existing design speed along the project corridor varies due to several reconstruction projects that have occurred since the construction of the initial I-70 corridor. The existing design speed, based on design criteria at the date of corridor as-built plans, varies between 50 mph and 65 mph. The speed limit from milepost 215 to 215.9 is 50 mph and the remaining stretch of the project is 65 mph.

2.2 Existing Horizontal Alignment

The preliminary project control line created by Ulteig is located along the centerline of the westbound I-70 roadway. The curve radii from the preliminary project control line, were estimated based on 2011 LiDAR data and aerial imagery, summarized in Table 1. The intent of this project is to widen the roadway only, therefore matching the existing roadway geometry. The three horizontal curves with substandard radii do no appear to have safety issues in evaluating existing crash data.

Figure 2. Overview of curve locations

Curve Number	WB I-70 Project Control Line Curve Radius (ft)	Posted Curve Speed (mph)	Minimum Recommended Curve Radius* (ft)	Meets Standards
1	1500	50	1120	☒
2	1870	65	1480	☒
3	11000	65	4200	☒
4	5720	65	5720	☒
5	2020	65	1480	☒
6	1970	65	2070	☐
7	6140	65	6140	☒
8	2300	65	2600	☐
9	12500	65	12900	☐
10	1720	65	1480	☒

*The minimum recommended curve radius was determined based on the posted speed and the maximum recorded superelevation (see Table 2) from the 2011 LiDAR data.

Table 1. Existing Curve Radius and Design Speed Summary

2.3 Existing Vertical Alignment

A preliminary vertical alignment was created along the project control line using 2011 LiDAR data. The vertical alignment is intended to match the existing ground as closely as possible. Several locations along the corridor exceed the maximum vertical grade recommended by CDOT's 2018 Roadway Design Guide of 5% for 65 mph. The maximum vertical grade measured was approximately 6.93%. All vertical curves met current American Association of State Highway and Transportation Officials (AASHTO) criteria for the posted speeds. On the final ascent towards the continental divide, grades increase on average 4.1% from Bakerville to EJMT, compared to 2.8% from Silver Plume to Bakerville.

2.4 Existing Superelevation

The existing superelevation rates were measured using cross sections built from 2011 LiDAR data. These superelevation rates are summarized in Table 2 along with the recommended superelevation rates per AASHTO design standards. Improvements and/or modifications to the existing superelevation rates are not planned at this time. Superelevation rates will be evaluated further after completion of the roadway survey, during the preliminary and final design.

Horizontal Curve Number	WB I-70 Project Control Line Radius (ft)	Maximum Recorded Superelevation	Recommended Superelevation ($e_{max} = 8\%$)
1	1500	7.3%	6.2%
2	1870	9.0%	7.6%
3	11000	4.3%	2.0%
4	5720	3.3%	3.2%
5	2020	10.6%	7.4%
6	1970	7.3%	7.4%
7	6140	3.0%	3.0%
8	2300	6.3%	6.8%
9	12500	1.8%	2.0%
10	1720	8.4%	7.8%

Table 2. Superelevation Rates of Existing Horizontal Curves

2.5 Existing Median Cross Overs

There are four existing median cross overs located on the corridor for use by emergency and authorized vehicles. These can be found at approximately MP 217.5, MP 218.7, MP 219.4, and MP 220.7.

2.6 Existing Interchanges

Bakerville Interchange (MP 221.3)

This is a standard diamond interchange with access to recreational trails on the south side of the interchange. A few residential homes exist on both sides with Silver Valley Road traveling on the south side connecting back east to the Town of Silver Plume. The WB on ramp curves around a large rock outcropping where a weather station also exists. Both ramps to and from WB I-70 meet AASHTO design standards for length.

Herman Gulch Interchange (MP 218.4)

This is a standard diamond interchange with access to recreational trails on the north side of the interchange along with access to seasonal cabins. Both ramps to and from WB I-70 meet AASHTO design standards for length.

US 6 Interchange (MP 216)

I-70 WB travels at a southwest direction through the US 6 interchange and curves west around the edge of a mountain creating sight distance issues for both WB and EB travel. The US 6 WB ramps consist of a tapered off ramp and a loop on ramp. These ramps come together as a two-way roadway before passing underneath I-70 where they intersect US 6. The loop for the WB on ramp is posted for 15 mph. The acceleration length for the WB on ramp is only approximately 540 feet long which does not meet the AASHTO recommendations of 2,498 feet for merging onto a 65-mph road on a 6% upgrade. The EB off ramp has a 90-degree bend to a stop condition at US 6. This bend does not provide sufficient room for larger vehicles to make the turning movement, causing the wheel path of larger vehicles to leave the road. For those wanting to get onto I-70 WB, they must turn left onto US 6 and take another left to access the loop on ramp. Continuing east on US 6, US 6 becomes a one-way road as it transitions to the EB on ramp at I-70. Both ramps to and from EB I-70 meet AASHTO design standards for length.

Figure 3. Aerial view of I-70 at the US 6 Interchange and Loveland Ski area

The Loveland Ski Area has western and eastern parking lots. To access the east parking lots, a left turn onto US 6 is required from both off ramps, intermixing with the EB US 6 traffic that is accessing EB and WB on ramps. Traffic backs up during the ski season as parking lots fill up and people are searching for a place to park, impeding highway traffic flow. Some vehicles chose to park along the western ramps on the dirt shoulder and along a narrow access road that parallels I-70 to the east. The eastern parking lots lack auxiliary lanes and do not contain a single-entry point but provide open access along US 6. Those traveling out of the Loveland Ski Area eastern parking lots impact EB ramp travel to the interstate.

Commercial vehicles hauling hazardous materials are not permitted to travel through EJMT and must exit at US 6, unless Loveland Pass is closed. A similar restriction also applies to over height vehicles as they approach EJMT. US 6 travels over Loveland Pass south of I-70 and connects back to I-70 on the west side of the tunnel at Silverthorne. Trucks required to leave I-70 and travel on US 6 detour approximately 20 miles.

2.7 Existing Road Conditions

The existing WB roadway surface appears to be in fair condition as a result of continuous maintenance and improvement projects. Recent construction projects in the area include:

- A 2.5" mill followed by a 2.5" overlay of SMA (STA 0703-426, 20510, M.P. 215.35 to M.P. 218.26) in 2016
- A 2" mill followed by a 2" overlay of HMA (Grading SX)(100)(PG 58-28) (STA 0703-432, 20850, M.P. 218.41 to M.P. 228.38) in 2017

Historic information from a 2016 Pavement Justification Report revealed the most prevalent distresses are fatigue cracking in the wheel paths, transverse cracking, and longitudinal cracking with the severity levels of low to medium. Block cracking is also observed at some locations. Moderate to severe rutting is also seen in the wheel paths.

Pavement cores will be taken to further document the existing road conditions.

2.8 Existing Guardrail

Table 3 summarizes the existing guardrail as found on CDOT's Online Transportation Information System (OTIS). There is very little existing guardrail found on the outside shoulder in the WB direction. Short sections of W-beam guardrail can be found along the outside shoulder at existing interchanges, the approach to EJMT, and near some existing features close to the road such as the existing variable message sign (VMS) at MP 217.4. Widening the roadway may cause additional obstructions to be within the roadway's clear zone and require additional guardrail.

Safety Feature	MP 216	MP 217	MP 218	MP 219	MP 220	MP 221
Median Safety Feature	Concrete Structural Fixed (Jersey)	3-Strand Cable	3-Strand Cable, Blocked Out W-Beam, 3-Strand Cable	3-Strand Cable	3-Strand Cable	3-Strand Cable, Blocked Out W-Beam, None
Primary (EB) Outside Shoulder Feature	Blocked Out W-Beam	Blocked Out W-Beam	Partial - Blocked Out W-Beam	Partial - Blocked Out W-Beam	Blocked Out W-Beam	Partial - Blocked Out W-Beam
Secondary (WB) Outside Shoulder Feature	Partial - Concrete Structural Fixed (Jersey)	None	None	None	None	None

Table 3. Overview of Existing Guardrail

2.9 Existing Median

I-70 has an approximately 12' wide paved median with concrete barrier from EJMT to MP 216.66, where it transitions to a depressed median with natural vegetation that is typically 36' wide with cable guardrail that continues to the end of the project. CDOT's 2018 Roadway Design Guide recommends 26' flush medians and 52' depressed medians. Median widths through the corridor are generally restrained by the geography of the area.

2.10 Existing Roadside Features

A roadside memorial plaque listing the names of the victims who died from a plane crash in 1970 is located near the crash site, adjacent to westbound I-70, at Dry Gulch (MP 217.3). A trail to the wreck site via Dry Gulch is approximately 0.4 miles past the memorial off exit 216. The occupants of the plane were football players and personnel from Wichita State University. The memorial was built by the university for those who died from the crash and is commonly referred to as the Memorial '70. It is documented that every year on October 2 at 9 a.m., a wreath is placed at this memorial. **Figure 4** of the memorial site shows active visitation occurs.

Figure 4. Roadside memorial at MP 217.3

3 EXISTING STRUCTURAL CONDITIONS

On September 14, 2022, Ulteig visited the study area to assess the condition of the existing major structures. The following five major structures were identified on I-70 between I-70 MP 216 and MP 222, with the corresponding structure numbers shown in parenthesis:

1. I-70 Mainline Westbound Bridge over US-6 (F-13-O)
2. I-70 Mainline Eastbound Bridge over US-6 (F-13-P)
3. I-70 Mainline at Herman Gulch Eastbound Bridge (F-13-L)
4. I-70 Mainline at Herman Gulch Westbound Bridge (F-13-J)
5. Bridge over I-70 Mainline at Bakerville On/Off Ramps (F-13-T)

Figure 5 shows the locations of the five structures and Table 4 provides the location by MP and the corresponding sufficiency rating. Each of the structures is discussed in more detail in the following sections.

Figure 5. Overview of structure locations

Description	Location (MP)	Structure Number	Built	Sufficiency Rate (date)
3-span, non-continuous steel plate girder bridge over US Highway 6	216.185	F-13-O	1964	81.2 (Sept 14, 2021)
3-span, continuous steel plate girder bridge over US Highway 6	216.185	F-13-P	1979	97.2 (Sept 14, 2021)
3-span, continuous parabolic reinforces concrete bridge over Herman Gulch Road	218.299	F-13-L	1972	95.3 (May 4, 2021)
3-span, continuous parabolic reinforces concrete bridge over Herman Gulch Road	218.3	F-13-J	1972	94.3 (May 4, 2021)
2-span, continuous steel plate girder bridge over I-70	221.25	F-13-T	1971	73.3 (May 4, 2021)

Table 4. Summary of Structures (Information taken from Structure Inspection Reports)

3.1 Major Structures

3.1.1 Structure F-13-O

F-13-O (Westbound) was built in 1964 and is a non-identical twin structure of F-13-P (Eastbound). The bridge is located at mile post 216.18 and crosses US Highway 6. The structure is a three-span, non-continuous steel plate girder supported by seat type abutments and multi-column bents. The roadway is on a horizontal curve alignment with varying skews and is on a 6.4% vertical grade. The bridge has a sufficiency rating of 81.2 according to the CDOT Structure Inspection and Inventory Report, dated 9/14/2021.

F-13-O is in direct contact with structure F-13-P via a longitudinal compression joint located in the median of I-70. There is one 4-inch diameter utility conduit attached to the left barrier on the outside of the bridge.

Figure 6. Elevation view (looking north)

Deck Topside

The driving surface of the deck has a 3-inch-thick asphalt overlay. The top of the concrete deck is not visible. Several patches of asphalt exist throughout the overlay and there several are areas of potholing and delamination of the top layer of asphalt. The asphalt is cracked the entire width of the roadway at both abutments and Pier 3.

The bridge rail is concrete barrier. The bridge rail on the right side of the traveled way is not attached to structure F-13-0 but is attached to F-13-P and acts as a median barrier. Spalls with exposed, corroded reinforcement is present throughout much of the length of the left bridge rail.

At Pier 2, the concrete joint header is abraded in the traffic lanes exposing aggregate. The anchors for the joint armor are also exposed through top of the header; no metal sections appear to be protruding from the header. The seal is impacted with debris most of its length.

Original plans show expansion joints at both Piers, but there is only an expansion joint at Pier 2. It is likely Pier 3 expansion joint has been paved over.

Figure 7. Asphalt patches in wearing surface.

Figure 8. Typical deterioration of outside bridge rail

Figure 9. Expansion joint at Pier 2

Figure 10. Transverse cracking of asphalt over Abutment 1

Deck Underside

The underside of the deck has several areas that have had full depth concrete repairs. Several locations existing with patches less than 2 square feet in area in Bays 1B, 1D, 2B, and 3C. Some patches are cracked with efflorescence. There are also several areas of map cracking with efflorescence, scattered throughout the deck. Areas with efflorescence and patch account for 10% of the deck area.

The left edge of the deck has several areas of spalling with exposed and corroded reinforcement. The right edge of the deck along the expansion joint is in good condition, however the joint with bridge F-13-P allows water through and collects on Girder E.

Figure 11. Drainage through longitudinal joint with F-13-P on to Girder E, corrosion on top flange of Girder E

Figure 12. Typical view of underside of deck showing areas of patch and cracking with efflorescence

Girders and Bearings

The bridge girders are in overall fair condition, but several localized areas in poor condition.

Throughout the girders, cross frames, bearings, and other steel components the paint has failed and there are areas of surface corrosion. The corrosion is most severe on the exterior faces of the exterior girders and at the girder ends underneath the deck joints. Girder E has pitting the full length along the top flange and web and has 30% section loss of its web at Abutment 1.

Girder 1A is buried in 4ft of gravel and other debris for 10ft of its length at Abutment 1. The material is unable to be removed with hand tools. In areas where Girder 1A was uncovered and cleaned, only surface rust was observed. A complete uncovering and cleaning of Girder 1A is required to fully document its condition.

An additional observation of Girder 1A, when large vehicles cross the bridge in the driving lane or on ramp, Girder 1A laterally vibrates, up to ¼" from its resting position. The observation was not made on other girders.

The fixed bearings at both abutments are corroded and covered by debris. The movable rocker bearings are also corroded with debris on them from the deck joints above.

Figure 13. Debris on Girder 1A with uncovered area

Figure 14. View showing general condition of superstructure paint and corrosion on girders

Figure 15. Typical condition of movable bearings, Pier 2 Girder A

Abutments

Both abutments are in fair condition. At Abutment 1, there are delaminations running the length of the front of the girder seats under Girders C, D, and E. Some areas of the delamination exhibit rust staining. Water drains

across the entire length of the girder seat from Girder E to A. The likely source of the water is through the longitudinal joint with F-13-P at the right side of the bridge.

Abutment 4 has similar delaminations and rust staining to Abutment 1 under Girders D and E. A previously patched area at the right end of Abutment 4 has failed and is now spalled with exposed, corroded reinforcement.

The berms in front of both abutments are extremely steep and comprised of erodible sand and silt material. The slopes sit at close to a 1:1 slope in areas have sparse rip rap protection. Erosion troughs are present at several locations on both embankments. There is an active drainage on the Abutment 4 embankment originating from the right end of Abutment 4 despite the lack of rainfall prior to the inspection.

Figure 16. Delamination and rust staining on Abutment 1 girder seat

Figure 17. Delamination, rust staining, and failed patch at right end of Abutment 4

Piers

The piers are in overall fair condition. There are patches throughout both pier caps. Many patches are cracked and are unsound. There are spalls with exposed reinforcement along the bottom edges and ends of both pier caps. All pier columns have chips near their bottoms throughout as well insignificant width cracks.

Figure 18. Failing, cracked patches on bottom edges of Pier 3

3.1.2 Structure F-13-P

F-13-P (Eastbound) was built in 1979 and is a non-identical twin structure of F-13-O (Westbound). The bridge is located at mile post 216.18 and crosses US Highway 6. The structure is a three-span, continuous curved steel plate girder supported by seat type abutments and multi-column bents. The roadway is on a horizontal curve alignment with varying skews and is on a 6.4% vertical grade. The bridge has a sufficiency rating of 97.2 according to the CDOT Structure Inspection and Inventory Report, dated 9/14/2021.

F-13-P is in direct contact with structure F-13-O via a longitudinal compression joint located in the median of I-70.

Figure 19. Elevation view

Deck Topside

The driving surface of the deck has a 4-inch-thick asphalt overlay. The top of the concrete deck is not visible. Potholes and dishing exist throughout much of the wearing surface with most severe concentration in Span 1. The paving seam along centerline roadway is crack up to 6in wide. Transverse cracks that run the full width of the roadway exist over Abutments 1 and 4.

The bridge rail is concrete barrier. The left bridge rail on F-13-P also serves as the right bridge rail on F-13-0. Spalls with exposed, corroded reinforcement is present throughout much of the length of both bridge rail.

A strip seal expansion joints is located at Abutment 1. The concrete joint header is abraded in the traffic lanes exposing aggregate. The anchors for the joint rail are also exposed through top of the header; no metal sections appear to be protruding from the header. The seal is impacted with debris most of its length.

Figure 20. Typical potholes in asphalt wearing surface

Figure 21. Expansion joint at Abutment 1

Figure 22. Transverse cracking in asphalt wearing surface over Abutment 1

Figure 23. Typical spalling with exposed corroded reinforcement in the concrete barriers

Deck Underside

The underside of the deck has scattered areas of transverse cracks with efflorescence. A few locations with map cracking with efflorescence exist, Bay 1B near Abutment 1 and Bay 3C and 3B near Abutment 4. The underside of the joint headers at the abutments both have cracking with efflorescence throughout.

Figure 24. Typical view of underside of deck showing areas of cracking with efflorescence

Figure 25. Cracking with efflorescence on underside of joint header at Abutment 4

Girders and Bearings
The bridge girders are in overall fair condition. Throughout the girders, cross frames, bearings, and other steel components the paint system has failed exposing primer and areas of surface corrosion.

The bearings at both abutments are covered in debris, which may be restricting movement.

Figure 26. Typical condition of movable bearings, Abutment 1 Girder B

Abutments
Both abutments are in good condition. There are scattered vertical insignificant width cracks throughout both abutment backwalls. There is one spall with exposed reinforcement on Abutment 1 in Bay D. The girder seats for both abutments are covered in debris.

Figure 27. Spall with exposed reinforcement on Abutment 1, Bay D

Piers
The piers are in overall good condition. Some insignificant width cracks are present in the caps and columns of both piers. The pier columns have chips near their bottoms throughout.

3.1.3 Structure F-13-L

F-13-L (Eastbound) was built in 1972 and is a twin structure of F-13-J (Westbound). The bridge is located at milepost 218.30 on I-70 and crosses Herman Gulch Road. The structure is a three-span, continuous parabolic reinforced concrete T-girder supported by integral abutments and multi-column bents with integral pier caps. The structure is on a straight alignment with no skew on a 3.74% vertical grade. The bridge has a sufficiency rating of 95.3 according to the CDOT Structure Inspection and Inventory Report, dated 5/4/2021.

Figure 28. Elevation View

Deck Topside

The driving surface of the deck has a 6 ½ inch thick asphalt overlay. The top of the concrete deck is not visible. The asphalt wearing surface is rutted in the driving lane wheel lines almost the entire length of the bridge. In some locations the ruts are up to 3 inches deep. The asphalt is also cracked up to 1 ½ inches wide along the longitudinal paving seam between the traffic lanes.

The bridge rail is galvanized Type 10M and is a retrofit to the original rails on the bridge. At many locations the anchor bolts for the rail do not extend beyond the curb enough to fully engage the nuts. The post base plates are also wider than the top of the curb and not fully seated on the curb.

The front face of both curbs is hidden by the asphalt wearing surface. At the ends of the approach curbs at Abutment 4, adjacent to the roadway, large erosion holes are present from drainage flowing off the bridge.

Figure 29. Asphalt rutting in driving lane

Figure 30. Erosion holes at ends of approach curbs

Deck Underside

The deck has widespread deterioration throughout. Approximately 30% of the underside of the deck has visible cracking, efflorescence, delamination, spalls, or patches made to the concrete.

Map cracking with efflorescence is present in all spans and girder bays, with the most severe conditions present in Girder C, D, and E. Throughout the efflorescence, isolated spots of rust staining are present. Discoloration of the concrete, separate from efflorescence, is also present throughout the underside of the deck indicating water can infiltrate and move through the deck. Large areas of “permanent” form work is present in Bay 3D from previous concrete repairs that obstructed the inspection of the area. There is also a large full depth repair in Bay 2D. Several spalls were visible with exposed corroded reinforcement at both edges of the deck.

Figure 31. General view of the underside of the deck in Span 1

Figure 32. General view of the underside of the deck in Span 2

Figure 33. Permanent form work for concrete repair (Bay 3D) and map cracking with efflorescence (Bay 3C)

Figure 34.Typical spalling with exposed reinforcement at edges of deck

Girders

The girders are in overall good condition. Some vertical cracks less than 0.012 inches wide are present at isolated location on most girders. Diaphragm 3E has (1) vertical crack with efflorescence.

Abutments

Both abutments are in fair condition. A few vertical cracks less than 0.012 inches wide are present in both abutments. At both abutments the berms have settled or eroded exposing the piles. Piles are exposed 8 inches and 3 inches at Abutment 1 and 4 respectively. Probing underneath Abutment 1 indicated there may be a 2- to 5-inch-wide void behind majority of the length of the abutment. It is also noted at Abutment 1 the pile under Girder C is not centered in the abutment cap and pile flange is visible and near flush with the front face of the abutment.

Figure 35. Exposed piles at Abutment 1

Figure 36. Off-center pile under Girder C at Abutment 1

The berms in front of both abutments are steep and only locally protected with riprap. Areas of erosion and piles of debris are present at all 4 corners of the bridge.

Figure 37. Erosion of berm embankments

Piers
The piers are in overall good condition. There are small chips and graffiti on the pier columns.

3.1.4 Structure F-13-J

F-13-J (Westbound) was built in 1972 and is a twin structure of F-13-L (Eastbound). The bridge is located at milepost 218.30 on I-70 and crosses Herman Gulch Road. The structure is a three-span, continuous parabolic reinforced concrete T-girder supported by integral abutments and multi-column bents with integral pier caps. The structure is on a straight alignment with no skew on a 3.74% vertical grade. The bridge has a sufficiency rating of 94.3 according to the CDOT Structure Inspection and Inventory Report, dated 5/4/2021.

Figure 38. Elevation View

Deck Topside
The driving surface of the deck has a 5-inch-thick asphalt overlay. The top of the concrete deck is not visible. Many large patches exist in the wearing surface and correspond in location to patches and formwork seen on the underside of the deck. The patches are mostly in the driving lane over Girder Bay B and C. The wearing surface is cracked up to 1.5 inch wide the full width of the roadway behind Abutment 1 allowing excess water to enter behind the abutment.

The bridge rail is galvanized Type 10M and is a retrofit to the original rails on the bridge. At many locations the anchor bolts for the rail do not extend beyond the curb enough to fully engage the nuts. The post base plates are also wider than the top of the curb and not fully seated on the curb.

The front face of both curbs is mostly hidden by the asphalt wearing surface, but localized areas of cracking and delamination are visible. Spalls, some with exposed reinforcement, are present under several rail posts.

Figure 39. Asphalt patches in wearing surface

Figure 40. Disengaged nuts on bridge rail anchors

Figure 41. Delamination and spalls on the front face of the curbs

Deck Underside

The deck has widespread deterioration throughout. Approximately 30% of the underside of the deck has visible cracking, efflorescence, delamination, spalls, or patches made to the concrete.

Map cracking with efflorescence is present in all spans and girder bays, with the most severe areas shown in Girder Bays A, B, and C. Throughout the efflorescence, isolated spots of rust staining are present. Discoloration of the concrete separate from efflorescence is also present throughout the underside of the deck indicating water can infiltrate and move through the deck. Large areas of “permanent” form work are present in Bays 1C, 2B, and 2C from previous concrete repairs. These repairs obstruct the inspection of these areas. In accessible areas near the abutments, delamination of the deck was detected using a hammer to sound the concrete at a few locations near Abutment 1. Several spalls with exposed corroded reinforcement are visible at both edges of the deck.

Figure 42. General view of the underside of the deck in Span 1

Figure 43. General view of the underside of the deck in Span 2

Figure 44. General view of the underside of the deck in Span 3

Figure 45. Typical spalling with exposed corroded reinforcement at edges of the deck

Girders
The girders are in overall good condition. The girders are free from defects aside from a few chips on Girders 2A and 2C from over-height vehicle collisions likely due to the minimum vertical clearance of 16'-6" over Herman Gulch Road. There are also isolated locations where cracks with efflorescence emanating from the deck have extended into the girders.

Abutments
Both abutments are in good condition. A few vertical cracks less than 0.012 inches are present in both abutments.

The berms in front of both abutments are steep and only locally protected with riprap. Areas of erosion and piles of debris are present at all 4 corners of the bridge.

Piers
The piers are in overall good condition. There are small chips and scrapes on the pier columns.

3.1.5 Structure F-13-T

F-13-T was built in 1971 and carries Bakerville Road over I-70 at MP 221.25. The structure is a two-span, continuous steel plate girder supported by seat abutments and a hammerhead pier. The structure is on a straight alignment with no skew or vertical grade. The bridge has a sufficiency rating of 73.3 according to the CDOT Structure Inspection and Inventory Report, dated 5/4/2021

Figure 46. Elevation view

Deck Topside

The driving surface of the deck has a 2-inch-thick asphalt overlay. The top of the concrete deck is not visible. A few scattered cracks are present throughout the wearing surface. Asphalt has been paved over the compression joint seals at both abutments. The asphalt is cracked the full width of the roadway over both joints.

The bridge rail is galvanized steel with two channel rails on square tubular posts. The bridge rail is referred to as "Type N" by CDOT's bridge inspection unit. The bridge rail is not MASH compliant. The approach rail is also substandard, lacking stiffened transitions to the bridge rail, sufficient length, and end terminals. The length of the approach rails is restricted by the adjacent intersections. The end terminals are flared end caps and "turn down to ground" style.

Both curbs are deteriorated for majority of their lengths. The right curb is spalled with exposed corroded reinforcement for approximately 50% of its length and scaled or delaminated for most of the remainder. The left curb is scaled or delaminated for 80 to 90% of its length and has a few isolated spalls.

Both approach slabs are undermined on both sides of the bridge at the ends of the wingwalls. Undermining extends up to 5 feet under the approach slab at some locations. The curbs on the approach slabs are damaged to the extent that they are no longer effective.

The concrete protective coating applied to the deck overhangs and curbs is peeling or failed at most locations.

Figure 47. Typical spalls with exposed corroded reinforcement in curbs and "Type N" bridge rail

Figure 48. Transverse cracking of asphalt over compression joint at Abutment 3

Figure 49. Typical undermining of approach slabs and damage to curbs on approach slabs. Right side of rear approach slab

Deck Underside

The underside of the deck has large areas of transverse and map cracks, with efflorescence. The largest concentrations of the map cracking are in Bays 2B and 2C near Abutment 3 and in both spans near Pier 2. The transverse cracks are scattered throughout. A few spalls less than 6 inches in diameter, some with exposed reinforcement, are present on the left edge of the deck above eastbound I-70.

Figure 50. Typical view of underside of deck showing areas of cracking with efflorescence, Span 2 at Abutment 3

Girders and Bearings

The bridge girders are in overall fair condition. Throughout the girders, cross frames, bearings, and other steel components, the paint system has failed exposing primer and areas of surface corrosion. Areas experiencing the most severe corrosion are in the bottom flanges of the girders directly over I-70 and the left side Girder 1A over eastbound I-70. The girder ends also have surface corrosion for 4 to 5 feet beneath the compression joints at the abutments.

The elastomeric bearings at the abutments are crushing and bulging. Bearing 3E is the most severe, crushed approximately 15% of its depth and bulged approximately 10% of its thickness. The abutment bearings are all covered in debris and have surface corrosion on the bearing plates.

Figure 51. View showing general condition of superstructure paint and corrosion on girders

Figure 52. Crushing and bulging of bearing pad 3E

Abutments

The abutments are in fair condition. Horizontal delamination and rust staining on Abutment 1 are present in Bays A, C, and D. A previously patched area at the bottom edge of Abutment 1 has failed, exposing corroded reinforcement in Bay D. Both abutments have insignificant width vertical cracks in the abutment backwalls.

Isolated locations along Abutment 1 have been undermined, but no piles are currently exposed

The concrete protective coating applied to the abutments and wingwalls is peeling or failed at most areas across the girder seats and abutment backwalls.

Figure 53. Typical delamination and rust staining on girder seats, Abutment 1 Bay A

Figure 54. Failed patch exposing corroded reinforcement, Abutment 1 Bay D

Pier

The pier is in overall good condition. Some insignificant width cracks are present in the cap and wall. The pier is stained with rust from the girders and there is some graffiti on the north face.

3.2 Eisenhower Johnson Memorial Tunnel

Eisenhower Johnson Memorial Tunnel (EJMT) sits at the highest elevation along the I-70 corridor, and the eastern portal is at the western end of the project limits. The westbound portal was completed in 1973 and the eastbound portal was completed in 1979. The two portals are 115 feet apart at the east entrance. Each portal serves two lanes of one-directional traffic. The project's WB climbing lane will end upstream of the tunnel, so westbound I-70 will transition from three lanes down to two lanes prior to EJMT tunnel entrance. The East Portal sits at an elevation of 11,013 feet and the EJMT extends 1.7 miles west through the Continental Divide, connecting the western slope of the Rocky Mountains with the eastern slope.

EJMT is staffed 24 hours a day, 365 days a year to provide continual monitoring of the tunnel, road conditions and traffic. Cameras and weather stations exist along I-70 in the project limits to assist with this monitoring. Freight carrying hazardous materials is not allowed to travel through the tunnel unless Loveland Pass is closed. Metering of traffic at the tunnel approaches does occur on occasion due to weather, congestion, or incidents. The grade through the tunnel is 1.64 % rising to the west with the eastern approach on a 6% climbing grade.

The WB approach to the tunnel does have a pull-off area for trucks to check their brakes and a holding area for trucks carrying hazardous material or are over height or wide loads. The pull off area continues as a service road over the top of the tunnel entrance that can be used to turn trucks around, if needed. A parking lot of less than 30 spaces also exists on the west approach for the use of the employees that work there.

3.3 Minor Structures

The following four minor structures were identified on WB I-70 between I-70 MP 216 and MP 222. The four structures were classified as either CBC or CMP. The details of the minor structures and their existing conditions have been summarized:

1. Loveland Skier Underpass (MP 215.61)
2. Dry Gulch Culvert (MP 217.38)
3. Herman Gulch Culvert (MP 218.42)
4. Watrous Gulch Culvert (MP 219.29)

3.3.1 Loveland Skier Underpass

Minor culvert 070A215590BL was built in 1962 and is located at milepost 215.61. The culvert serves as an underpass for skiers to traverse under I-70 at the Loveland Ski Area, as well as providing a drainageway. The structure is a one cell 10 foot x 10 foot cast-in-place reinforced concrete box culvert. The culvert barrel is approximately 197 feet long and the fill depth varies from 3 feet at the inlet (north side of I-70) to 12 feet at outlet. I-70 above the structure is on a curved alignment and vertical grade. The culvert has a sufficiency rating of 56.0 according to the CDOT's Online Transportation Information System (OTIS).

Figure 55. Outlet Elevation

Figure 56. Inlet elevation

Figure 57. General view through culvert barrel

Existing Conditions

The culvert is in overall good condition. It is divided into two halves by a concrete divider: 4-foot-wide and 5'-6" wide. The wider section of the culvert lies on the left side when looking downstream. The culvert contains a lighting system for pedestrians with a metal conduit connected to an electrical panel at the south end of the barrel.

The culvert barrel has seven moderate to wide width circumferential cracks in the walls and top slab, with the cracks spaced over 20 feet apart. None of the cracks have evidence of leakage or efflorescence. There are 3 construction joints in culvert. The joint located 32 feet from the outlet (south) end of the culvert is spalled with evidence of leakage through the joint. The concrete divider on the bottom slab is also spalled at the same construction joint.

At the outlet (south) end of the culvert, the leading edge of the top slab is spalled with exposed reinforcement the entire width of the barrel. Both wingwalls are also leaning towards the inside of the barrel. The southeast wingwall is leaning 8 inches at its top, the southwest wingwall is leaning 4 inches at its top. At the culvert inlet (north end), there are four exposed rebars in the headwall due spalling and a lack of concrete cover.

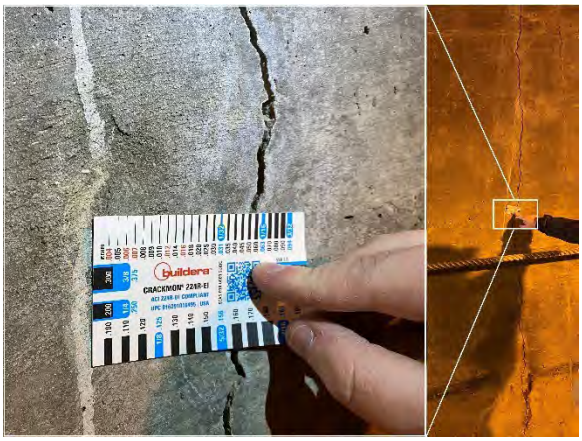


Figure 58. Typical wide width circumferential crack in culvert barrel

Figure 59. Spalling, leakage, and efflorescence at construction joint 32 feet from outlet

Figure 60. Spall with exposed rebar at outlet

Figure 61. Leaning of southeast wingwall

3.3.2 Dry Gulch Culvert (MP 217.38)

- 10.0 miles west of Georgetown
- Structure type – CMP
- Built in 1972
- Sufficiency rating 65
- Main facility carried I-70

3.3.3 Herman Gulch Culvert (MP 218.42)

- 9.0 miles west of Georgetown
- Structure type – CMP
- Built in 1972
- Sufficiency rating 54.8
- Main facility carried I-70

3.3.4 Watrous Gulch Culvert (MP 219.29)

- 8.1 miles west of Georgetown
- Structure type – CMP
- Built in 1972
- Sufficiency rating 43
- Main facility carried I-70

3.4 Miscellaneous Structures

In addition to major and minor structures through the project limits, there exists approximately 152 culverts ranging from diameter of 8” to 72” and a length of 5’ to 1311’.

There are two mast arms with structure id 070A215375B (westbound) and 070A215425A (eastbound) located at mile post 215.461 and 215.50 respectively.

4 EXISTING WATER RESOURCES, FLOODPLAIN, & WATER QUALITY CONDITIONS

An analysis of water resources, floodplains, and water quality issues was conducted as part of this existing conditions assessment in support of the CDOT I-70 WB Bakerville to EJMT Climbing Lane. This chapter provides basic information for water resources, floodplain, and water quality within the study area. The information was derived from site visits, published reports, and discussions with CDOT staff. Additional information is in the I-70 Mountain Corridor Final Programmatic Environmental Impact dated March 2011.

4.1 Current Watershed Conditions

The study area is located within the Upper Clear Creek watershed. The watershed is 394 square miles (mi2). Clear Creek originates at the continental divide, west of the study area, near the Eisenhower Tunnel and flows east to the confluence of the South Platte River in the Denver metropolitan area. The watershed falls within areas of the Arapaho and Roosevelt National Forest. Tributaries to Clear Creek along the project include Quayle Creek, Kearney Gulch, Watrous Gulch, Herman Gulch and Dry Gulch.

The I-70 corridor follows the main stem of Clear Creek in the study area. A large portion of the watershed is steep rugged topography; therefore, the majority of development is along Clear Creek. Land uses in the watershed consist mostly of forest with small but developing communities, recreational use, transportation facilities – railroads and highways, and existing and historical mining operations. **Figure 62** from Upper Clear Creek Watershed Plan Update 2014 (Watershed Plan) identifies the subbasins of the Upper Clear Creek Watershed. The project falls within basin 0102.

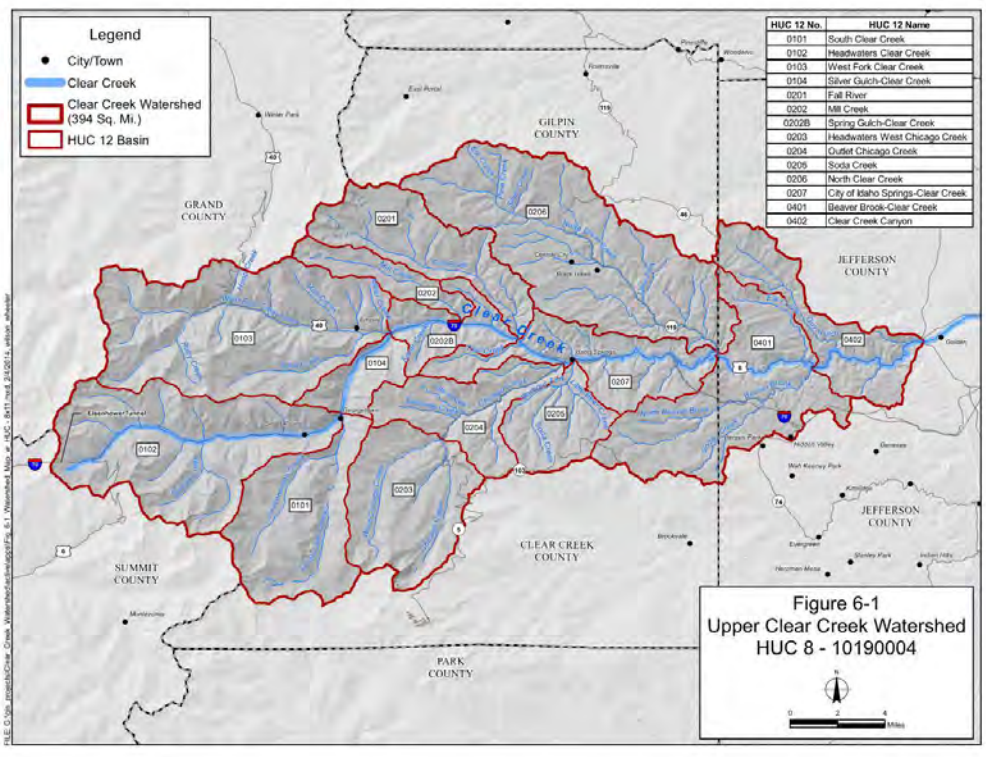


Figure 62. Upper Clear Creek Watershed

Clear Creek and its tributaries also serve as the primary drinking water supply for seven of the upper watershed towns. It also feeds one of the metro area reservoirs.

The United States Geological Survey (USGS) StreamStats identifies there are many washes that could cross I-70 within the project in addition to the major crossings. Drainageways are shown in blue in **Figure 63 and Figure 64** (figures from StreamStats).

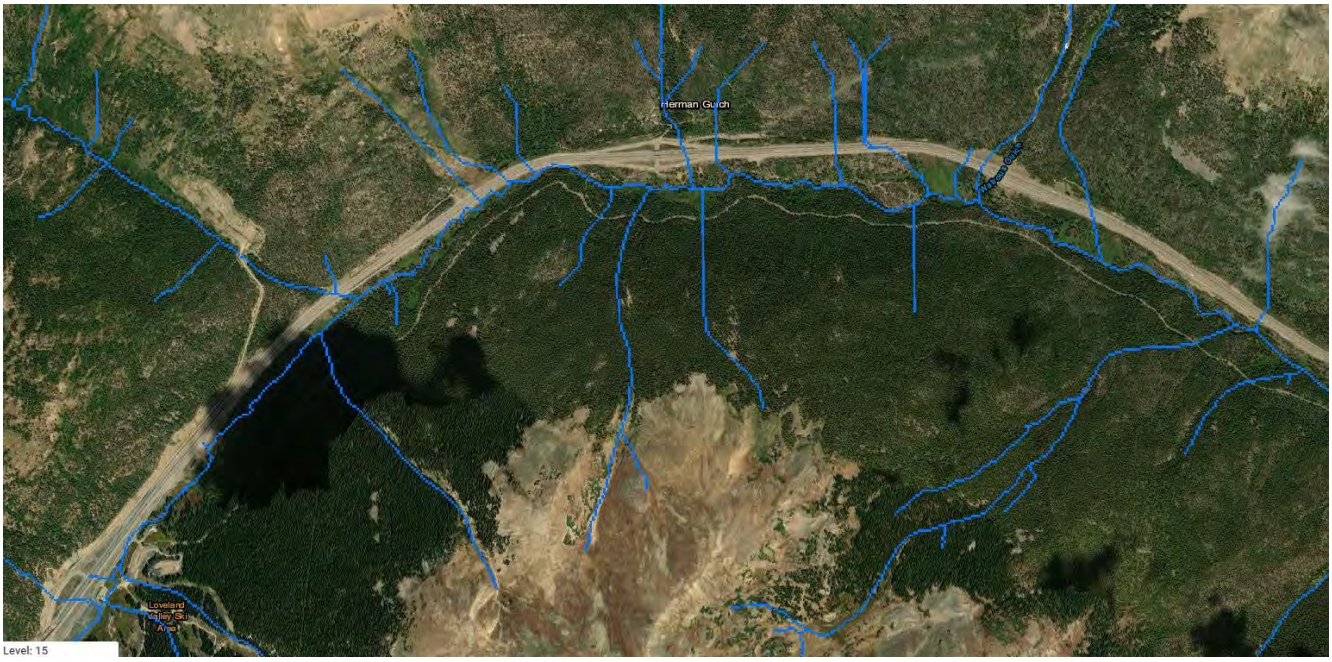


Figure 63. Drainage crossing west – East EJMT to Watrous Gulf

Figure 64. Drainage crossing west – Watrous Gulch to Bakerville

4.2 Clear Creek and Floodplain

Clear Creek is a perennial stream that flows along I-70 through the study area. Portions of Clear Creek were channelized with the construction of I-70 in the 1950s. The creek is a typical mountain stream with large cobbles and boulders and steep channel banks. It has a low stream sinuosity (ratio of the stream length to the valley length), slight meandering, and limited riparian (streamside) vegetation.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) includes Clear Creek within the project. Clear Creek runs west to east along the south side of I-70 within the project limits. The mapped floodplain is shown on FIRM Clear Creek County, Colorado and Incorporated Areas Map Number 08019C0175D, Effective Date March 19, 2007. Clear Creek is identified as a Zone A FEMA mapped floodplain. The limits of Clear Creek Zone A are near Herman Gulch, MP 218 on the west to the east limits of the project. The effective floodplain is shown in **Figure 65**.

The FEMA Flood Insurance Study (FIS) for Clear Creek County, Colorado and Incorporated Areas FIS Number 08019CV000C discusses the analysis of the floodplain study.

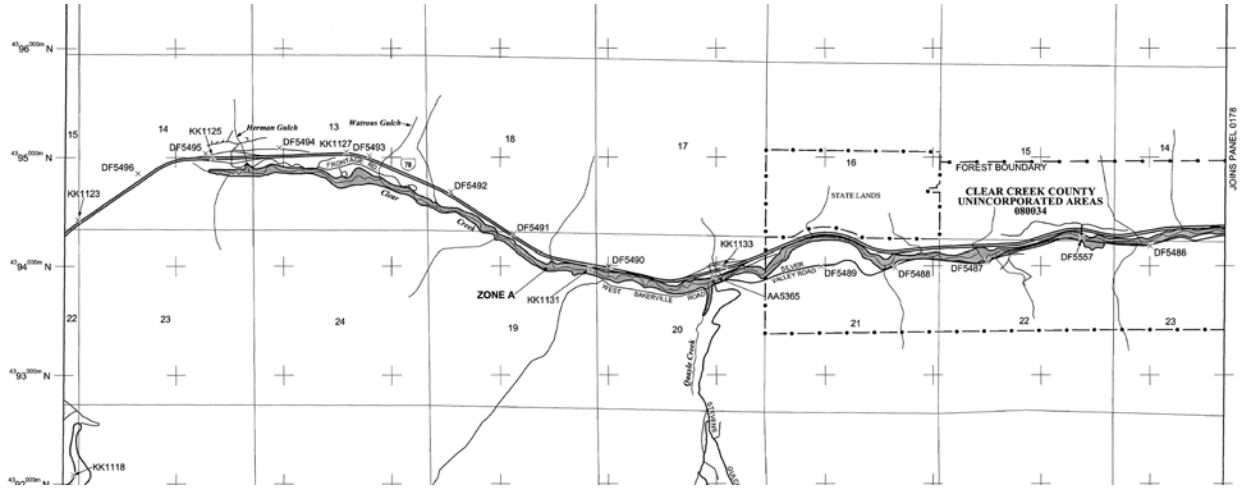


Figure 65. FEMA floodplain

4.3 Clear Creek Water Quality

Historic activities in the Clear Creek watershed, including mining, industry, recreation, and transportation have impacted the water quality of Clear Creek. The Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission Regulation No. 93 Colorado's Section 303(D) List of Impaired Waters and Monitoring and Evaluation List for the year 2021 was referenced for the latest water quality stream data collected. This is also known as the Section 303(d) list of impaired waters and monitoring and evaluation list. The mainstem of Clear Creek, within the project area, is included in segment COSPCL01 which includes the mainstem of Clear Creek, including all tributaries and wetlands, from the source to the I-70 bridge above Silver Plume, except for Kearney Gulch and Grizzly Gulch. This segment of Clear Creek is categorized as 1a/meets designated uses. Kearney and Grizzly Gulch have been retained on the M&E list which means there is insufficient data to make a determination. Downstream of the project at Silver Plume Clear Creek segment COSPCL02A_B is designated as 303d.

Figure 66 is from CDPHE impaired waters 303(d) ArcGIS online maps within the project areas.

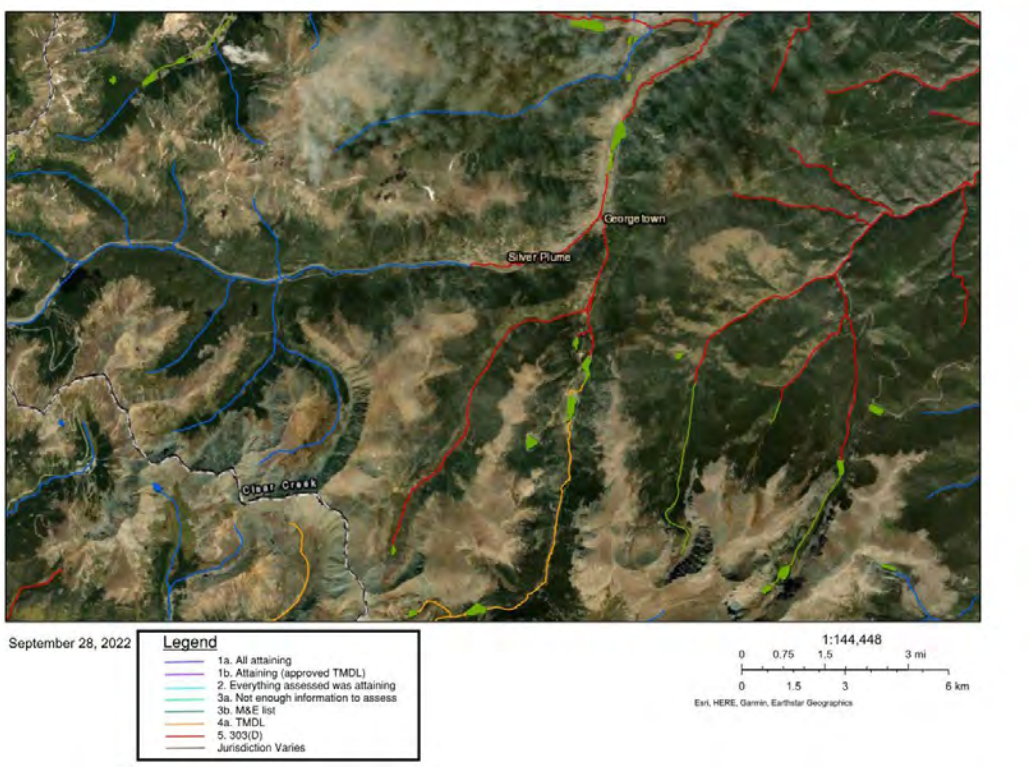


Figure 66. CDPHE stream segmentation

Clear Creek is monitored and has extensive water quality data including trace metal and nutrient concentrations. The trace-metals database is updated annually. The Watershed plan states that monitoring results show that high sediment concentrations result in higher nutrient and total trace-metal concentrations in Clear Creek. Sediment is the primary source of nutrient loading for total phosphorus and nitrogen resulting in values that exceed the proposed standard. Seasonal nutrient loads generated by sediment are two to three times greater than ambient (non-storm event) loads each year. The primary sources of sediment are from roads and unconsolidated mine waste residuals. Due to the recreational uses and environmental sensitivity of this reach of Clear Creek, CDOT has identified additional water quality requirements to be met with proposed projects in this study area to control and mitigate the impacts of sand and de-icer applications along the highway. The Stream and Wetland Ecological Enhancement Program Memorandum of Understanding was signed January 4, 2011 and provides direction for future projects through the I-70 Mountain Corridor.

Clear Creek mainstream receives it water from the source. This water serves all tributaries and wetlands in Clear Creek, except Kearney Gulch and Grizzly Gulch. Within the project area are Dry Gulch, Herman Gulch and Kearney Gulch.

The major existing water quality concern for this study area is disturbance of existing contamination, including heavy metals found in mine tailings and the application of sand and de-icing agents on I-70. Currently, there are no water quality treatment facilities along this section of I-70.

A Sediment Control Action Plan (SCAP) was developed in 2013 for the I-70 corridor with DOT and the local mountain communities participating. This document aids CDOT and other agencies manage roadway traction sand and other highway-related sediment sources that can adversely impact Clear Creek. CDOT has committed to implementing the SCAP for all reconstruction projects. This document was specifically developed for Clear Creek I-70 corridor between EJMT and Floyd Hill at Beaver Brook (MP 248). It provides guidance for environmental considerations and requirements, BMP design tools, CDOT maintenance program and

implementation approach plan. The SCAP provides a map of sedimentation along this corridor. High traction sand use and/or highway slope erosion were found in the Project area. See **Figure 67** (SCAP Figure 2-7).

Figure 67. Sedimentation along I-70

In the 2014 Watershed Plan the sub-basin that covers the project was found to be high in spills form highways or publicly owned treatment works, highway sediment/salt loading, metal, and aggregate mining and moderate-high for channel erosion from hydrologic modification. The SCAP provides a sediment control strategy, hydraulic analysis, and treatment BMPs. Recommended preventive BMPs include snow fence, roadside ditches and swales, curb and gutter, clean water diversions, and snow storage. Recommended treatment BMPs include detention/sedimentation basins, loading dock sediment trap, inlet sediment traps and “sand cans”, underground vaults, infiltration-based retention areas, filter based, bioretention, filter strips and vegetated swales, constructed wetlands and erosion control.

The water quality approach will follow the recommendations in the SCAP for drainage analysis, BMPs, approach, targeted sources of pollutants.

There is currently one permanent water quality control measure near the project area, located near MP 223. This control was installed in 2019. This structure was found on CDOT OTIS.

5 EXISTING GEOTECHNICAL CONDITIONS

5.1 Avalanche

The main avalanche area along this section of corridor is located from MP 217.8 to 217.9. This avalanche path extends to the northwest above I-70 towards Mt. Bethel. Various mitigation methods have apparently been used in the past such as wind fences on top near the summit of Mt. Bethel and recontouring the slopes just above I-70 in an effort to break up an avalanche from impacting the roadway.

5.2 Debris Flow Pathways

The main historic debris flow that closed I-70 for a significant time period is located at what is known as Watrous Gulch located at MP 219.2. The USGS summarized the debris flow in a field trip publication (Coe, Open-File Report 02-398) in 2002. There is potentially a wildlife crossing planned at this location, but future debris flows will undoubtedly impact a future structure and should be considered when finalizing wildlife crossing locations in the design. At this time, it appears the areas above the other proposed wildlife crossings are mostly vegetated, but future forest fires and subsequent debris flows should be considered in the design.

5.3 Existing and Potential Landslides

The main historic landslide in this section of corridor is at the east portal of the westbound EJMT tunnel complex at MP 215. A large buttress was constructed over the tunnel portal to stabilize the hillside at this location.

Figure 68. Historic EJMT landslide area and buttress located at MP 215

Other potential large scale landslide sections extend from MP 215.5 to 216.4. The area above is mapped as Idaho Springs Formation (Als) with glacial till (Qgt). The feature is not specifically mapped as a landslide but exhibits many of the geologic surfical conditions that are indicative of a landslide area. Potential cuts in the slope in this section may require an extensive geotechnical and geological investigation. Alignments that avoid cuts in this area would be preferable. If cuts are unavoidable, then extensive and creative slope stabilization mitigation may be required if there is the potential for a large-scale landslide.

Figure 69. USGS Mapped landslide area above I-70 from MP 215.5 to 216.4

Figure 70. Aerial view from US 6 interchange of landslide area above I-70 (MP 215.5 to 216.4)

5.4 Rockcuts and Ditch Widths

The existing rockcuts at the Bakerville exit were excavated using presplitting blasting techniques. Presplitting is generally the most straightforward blasting method and provides for the most stable rockcuts. However, it does leave a half cast of the vertical drill hole. **Figure 71** shows the westbound exit ramp at Bakerville (MP 221.3). Much of the I-70 corridor from Silver Plume to west of the Bakerville exit consist of presplitting with half casts.

Figure 71. Bakerville exit presplit rockcut

Some CSS related projects discourage presplit blasting techniques in favor of cushion or other blasting techniques. Cushion types of blasts generally leave a relatively unstable rockcut face that is much more prone to rockfall and unstable rock slopes. **Figure 72** below depicts a cushion blast on US 6 just east of the Bakerville exit.

Figure 72. US 6 cushion blast type rockcut

Cushion type rockcuts, while possibly more visually appealing than presplit, will require a much wider rockfall catchment ditch and/or other forms of rockfall netting and/or mesh to keep rockfall from impacting I-70. Depending on which rock blasting technique is permitted, the initial roadway design should consider the type of blasting cut proposed or accepted. Presplits are generally more stable and require less ditch vs cushion blasting that may require additional ditch width and/or mesh to ensure less rockfall on I-70.

6 EXISTING UTILITY CONDITIONS

6.1 Methodology

Subsurface Utility Engineering (SUE) Level C investigations are required during design and will be completed by the Farnsworth Group as part of the consultant team. This investigation will be in accordance with CDOT's 811 Summary (SB18-167) which requires location of underground utilities that meets or exceeds the Quality Level C.

6.2 Existing Conditions

Various overhead lighting exists within the project area. Lighting is provided for the parking lot and the truck pull-off in the approach to the EJMT, and lighting is provided along the chain stations. Electronic signs also exist in the approach to the EJMT and the chain stations. A mast arm with a traffic signal is used to meter traffic ahead of the eastern portal.

An underground fiber optic and electrical line runs parallel to I-70 on the north side of the westbound lanes. CDOT shares the fiber optic conduit with Comcast and Xcel Energy owns the electric lines. See figure below from bid plans of Project NO. SW 00-2264 I-70 Mesa, Garfield, Summit, Clear Creek, Jefferson Counties (Project Code 14606).

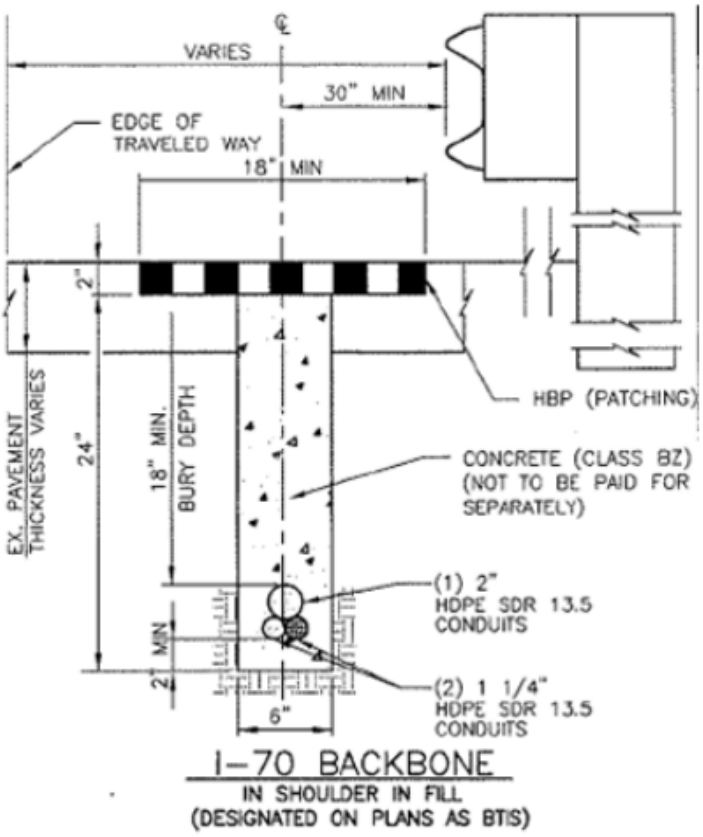


Figure 73. I-70 backbone diagram

Company/Agency	Utility Type	Name	Phone Number/Email Address
CDOT Region 1	Electric & Fiber		
CDOT ITS Fiber Backbone	Fiber	Jill Scott	(303) 512-5805 jill.scott@state.co.us
Century Link	Fiber & Telecom		
Comcast	CATV & Fiber	Local Contact – Tony Hildreth	(970) 589-5860 tony.hildreth@comcast.net
Xcel Energy	Electric, Gas, High Pressure Gas	Local Contact – Meredith Guinan	(970) 262-4022 meredith.quinan@xcelenergy.com
Zayo Bandwidth	Fiber Optic	Local Contact – Jeff Page	jeff.page@zayo.com
Lumen			
MCI/Verizon			

Table 5. Utilities Contact Information (**contacts pulled from other CDOT projects in the area, company/agency collected from 811 ticket)

7 EXISTING MULTIMODAL FACILITIES

7.1 Bicycle Facilities

The Bakerville to Loveland Trail runs parallel to I-70 on the south side of I-70 and Clear Creek, between Bakerville and the Loveland Ski Area. It is a 10-foot wide, paved, multi-use path that is also groomed in the winter months for fat bike, cross-country, and snowshoe access. There are parking areas at Bakerville and at the Loveland Ski Area for users to access the trail.

The US 6 Frontage Road (Silver Valley Road) east of the project area and US 6/Loveland Pass are designated as shared-use routes for vehicles and bicycles and provide connections to the east and to the west for regional bicycle trips.

7.2 Pedestrian Facilities

While pedestrians are prohibited on I-70 throughout the study area, the Bakerville to Loveland Trail provides the parallel connection that allows them to traverse from one end of the corridor to the other. Hikers use the Bakerville to Loveland Trail to access the Kearney Gulch hiking trail approximately one mile west of Bakerville, and the segment from Herman Gulch to Loveland Ski Area doubles as the Continental Divide Trail (CDT).

There are also two major hiking trailheads within the study area:

- The Bakerville interchange provides access to Grizzly Gulch Road and Stevens Gulch Road, the latter of which leads to the Grays Peak/Torreys Peak trailhead. An informal dirt parking area, along with 8 paved parking spaces, exist on the south side of the interchange. The parking area provides approximately 30 overall parking spaces for hikers/bicyclists and is filled on a regular basis on summer weekends.
- The Herman Gulch interchange serves as the trailhead for the Herman Gulch trail and provides access to the Watrous Gulch Trail and Bard Creek trail. It has an approximately 150-space parking lot that regularly fills early in the morning on summer weekends, with spillover vehicles parking along the westbound on- and off-ramps at the interchange. The USFS is currently designing a larger parking area to help alleviate the parking issues there.

Figure 74 shows the existing pedestrian and bicycle facilities in the study area.

Figure 74. Existing pedestrian and bicycle facilities and trails (source: Clear Creek County GIS website)

7.3 Transit Service

CDOT's Bustang/Snowstang regional transit service provides seasonal transit service to the study area. In the winter, Snowstang stops at the Loveland Ski Area at 8:30 AM and leaves the ski area at 4:00 PM every Saturday and Sunday during the ski season. During the summer, Bustang travels on I-70 but does not stop within the study area.

Although they do not stop within the study area, I-70 is used by the following transit and shuttle services:

- Greyhound
- Eagle Vail Express
- Epic Mountain Express
- Fresh Tracks Transportation
- Peak 1 Express
- Summit Express

8 TRAFFIC, TRAVEL FORECASTING, SAFETY, AND EXISTING ITS DEVICES

8.1 Roadway Environment

This segment of I-70 currently has two travel lanes in both the EB and WB directions. The EB and WB lanes of I-70 are separated by a median between Bakerville and the US 6/Loveland Pass exit, and by a concrete barrier between US 6/Loveland Pass and the EJMT entrance. There are three grade-separated interchanges along I-70 within the project limits (Bakerville, Herman Gulch and US 6/Loveland Pass) and chain up stations at MP 219.4 and MP 220.7.

The speed limit is posted at 65 mph with a minimum speed of 55 mph in the left lane. At MP 216 (near the US 6 Loveland Pass interchange) the speed limit is reduced to 50 mph as vehicles approaches the EJMT. There are variable speed limit signs for WB traffic at MP 220 (Bakerville on-ramp) and MP 221 (west of the Bakerville chain up station).

Colorado law requires that speed limits are not to be higher or lower than reasonable and prudent speeds under normal conditions (Section 42-4-1102, Colorado Revised Statutes). Posted speeds have limited effect on driver behavior; traffic investigations have shown that most people will drive the roadway as they perceive the conditions and will ignore a speed limit that is unrealistically too low or too high. To consider changing the posted speed of a roadway, a speed investigation is required that determines the prevailing speed, defined as the 85th percentile speed of motorists. Some speed studies have resulted in increasing the speed limit rather than reducing it.

CDOT is currently implementing variable speed limits (VSL) to the I-70 corridor between US 40 and Floyd Hill east of the study area. The concept of operations is based on the fact that after a certain critical threshold combination of speed and density is reached, the crash rate rises rapidly. The VSL project is developing an algorithm that will adjust speed limits based on volume, speed, weather, and road condition data. It will be first implemented in the eastbound direction using the existing VSL signs, followed by the westbound direction once the Floyd Hill widening project is complete.

The corridor's Annual Average Daily Traffic ranges is approximately 36,000 vehicles per day (vpd) near the EJMT, with WB Design Hourly Volumes at approximately 6.0 percent of the Annual Average Daily Traffic.

Observed field traffic data is contained in Appendix B of this document.

8.2 Data Collection Devices

CDOT collects a significant amount of traffic data along the I-70 Mountain Corridor using a variety of electronic devices listed below. These devices provided the data that was used to evaluate existing conditions for the study area.

- **Automatic Traffic Recorder (ATR).** These devices record volumes, speeds, and vehicle classifications on an hourly basis. There are ATRs at both portal entrances to the EJMT (MP 215.3 for the east portal and MP 213.6 for the west portal.
- **Microwave Vehicle Radar Detectors.** These devices use radar to record the speed of each vehicle. They are typically located on poles along the road and can also record speed data for each lane of a multi-lane facility. There are seven microwave vehicle radar detectors within the study area, four on the north side of I-70, two on the south side, and one in the median.
- **INRIX Data.** INRIX gathers real-time traffic data from commercial fleets, GPS, cell towers, mobile devices and cameras, and determines travel times and speed of vehicles through the corridor. INRIX data is available for the entire study segment (MP 215 to MP 221).

8.3 Seasonal Traffic Patterns

Figure 75 shows the monthly average daily traffic volumes at the EJMT ATR station. As the figure indicates, summer months (June through September) generate the highest daily traffic volumes, with winter volumes slightly lower. Traffic volumes drop significantly during the spring (April/May) and fall (October/November).

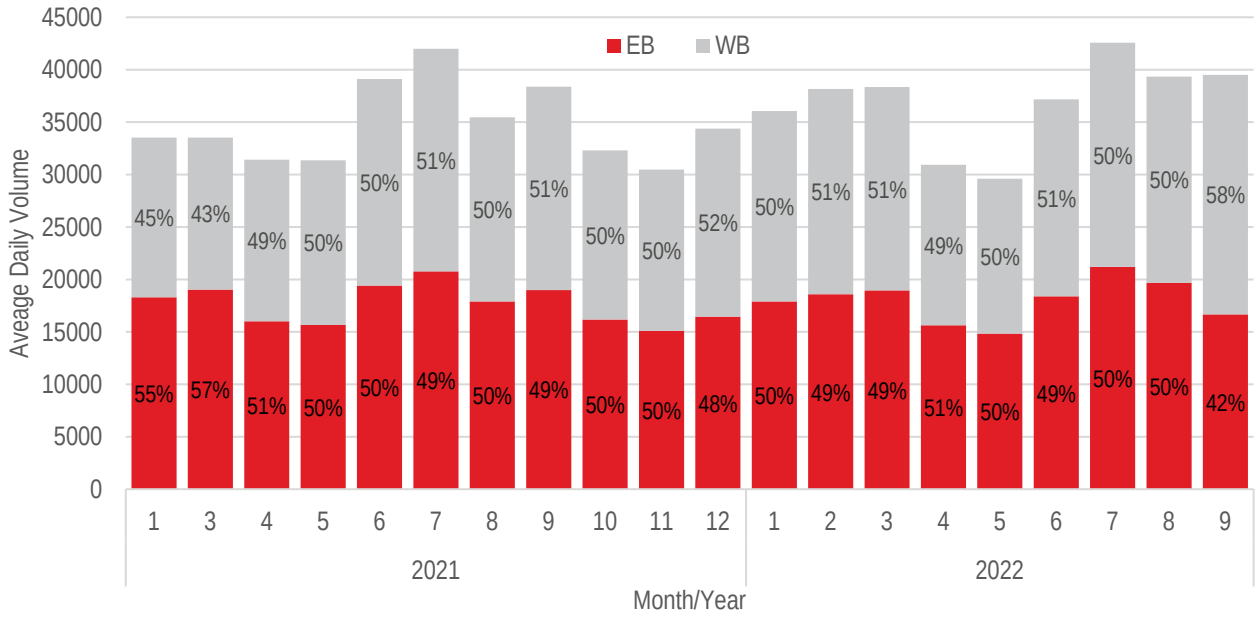


Figure 75. I-70 2021 & 2022 Average Daily Volumes by Month at EJMT

8.4 Daily Traffic Patterns

The I-70 mountain corridor is used for different purposes on weekdays (commercial, work, and recreation trips) and weekends (primarily recreation). **Figure 76** (summer) and **Figure 77** (winter) show that daily volume patterns during both seasons are highest on Friday through Sunday. While the total corridor traffic is highest on Sunday, westbound daily volumes are highest on Fridays and Saturdays as travelers drive into the mountains for recreational activities.

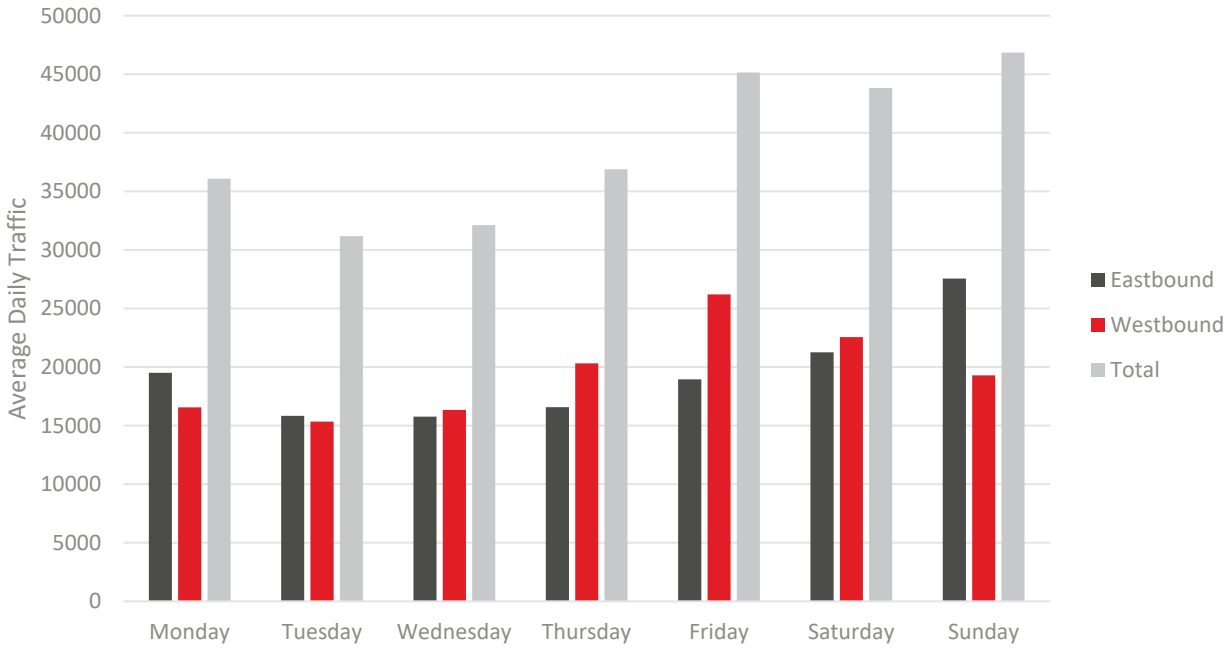


Figure 76. 2021 Summer Daily Traffic Patterns (June through September)

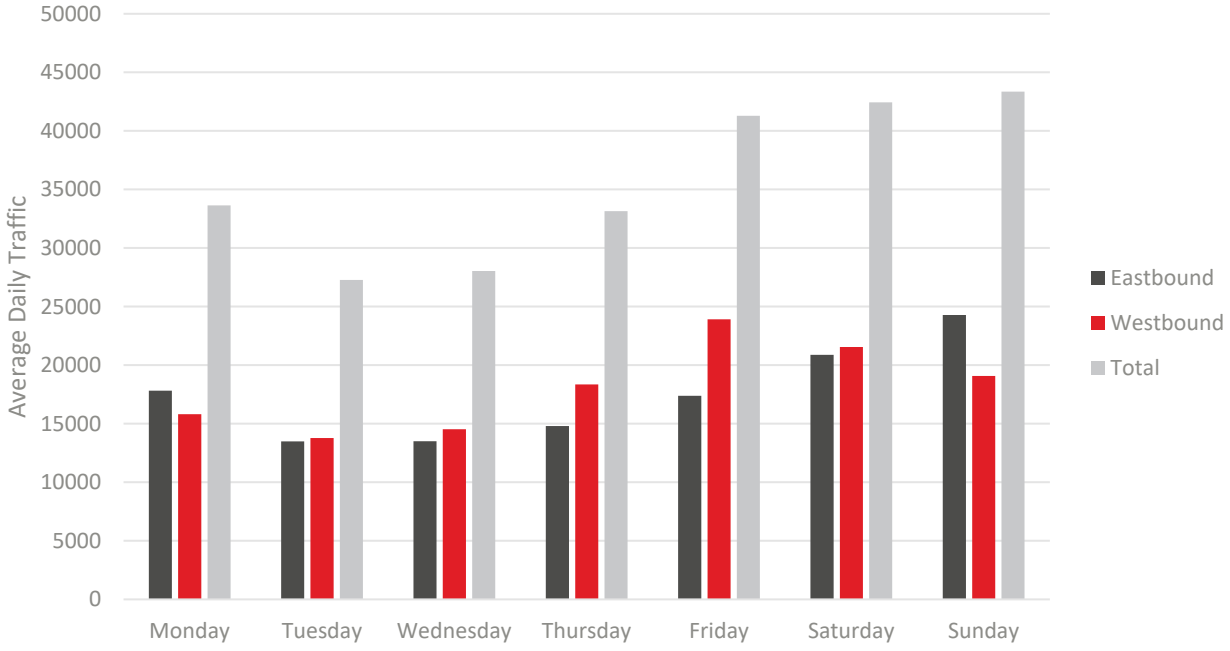


Figure 77. 2021 Winter Daily Traffic Patterns (December through March)

8.5 Truck Traffic

The annual average percentage of trucks traveling through the EJMT was 8.6 percent in 2021. Truck percentages vary by season due to variations in both truck volumes and passenger vehicle traffic. Further, truck volumes are lower and passenger traffic is highest during the weekend peak periods, so truck percentages on peak travel days are noticeably less than the annual average; winter weekend truck percentages are between 5 percent and 6 percent and summer weekend truck percentages are between 4 percent and 5 percent.

8.6 Chain-Up Stations

Colorado has a mandatory Chain Law which requires commercial vehicles, traveling in Colorado between September 1st through May 31st, to carry sufficient tire chains to be in compliance with the law. The law was initially enacted in 1996 and applies to all state, federal and interstate highways. Commercial vehicles without chains can often lose traction in inclement weather or poor road conditions, causing traffic delays and sometimes full closure of the highway. Passenger vehicles less than 16,001 pounds are required to carry chains if they do not have an all-wheel or four-wheel drive vehicle, or snow or all-weather tires with at least 3/16 inch tread.

There are two westbound chain-up stations on I-70 within the study area. The station at MP 220.7, west of the Bakerville interchange, provides 25 to 27 chain-up stalls over 2,345 feet of widened shoulder. The station at MP 219.4, east of the Herman Gulch interchange, provides 20 chain-up stalls over 1,640 feet of widened shoulder. The chain up stations consist of lighted parallel parking spaces of approximately 79 feet in length. The shoulder width at the chain-up stations are 15 feet versus the typical 10 foot outside shoulder. There is not a deceleration lane for vehicles to slow and pull into a stall, nor an acceleration lane for the vehicles to get back up to speed before entering traffic.

Commercial vehicles travelling slowly to find an open stall or waiting for one to vacate in the eastern-most chain-up station near Bakerville, cause large backups on the interstate. Traffic backups of 3 miles have been observed. Other commercial vehicles, where the driver is aware of the 2nd chain-up station, continue on and cause delays due to loss of traction on the uphill climb. Hazardous material drivers look for a stall covered in snow to help prevent any sparking as they chain up.

8.7 Design Day Volumes

CDOT has devices along the I-70 mountain corridor that continuously collect daily traffic volumes, so traffic data is readily available within the study area. For this project, data from the 2022 winter and summer peaks were analyzed. Conversations with CDOT indicated that the traffic evaluation should consider both a winter design day and a summer design day. Similar NEPA traffic evaluations for the I-70 WB PPSL and the WB Floyd Hill expansion projects considered traffic conditions based on 85th percentile volumes for those corridors, so for consistency with those evaluations, Saturday February 19, 2022 (President's Day weekend) was selected for the winter evaluation and Saturday July 9, 2022 was selected for the summer evaluation. The existing westbound daily volume on the winter design day within the Corridor was 25,420 vpd, which is generally representative of the 85th percentile volume for Fridays, Saturdays, and Sundays (typically the busiest days on the corridor) and 23,289 vpd on the summer design day, which is generally representative of the 85th percentile volume for the entire year.

On- and off-ramp traffic volumes were collected in August 2022 at the Bakerville, Herman Gulch and US 6 interchanges for this project.

Figure 78 shows the design day volumes for the study area.

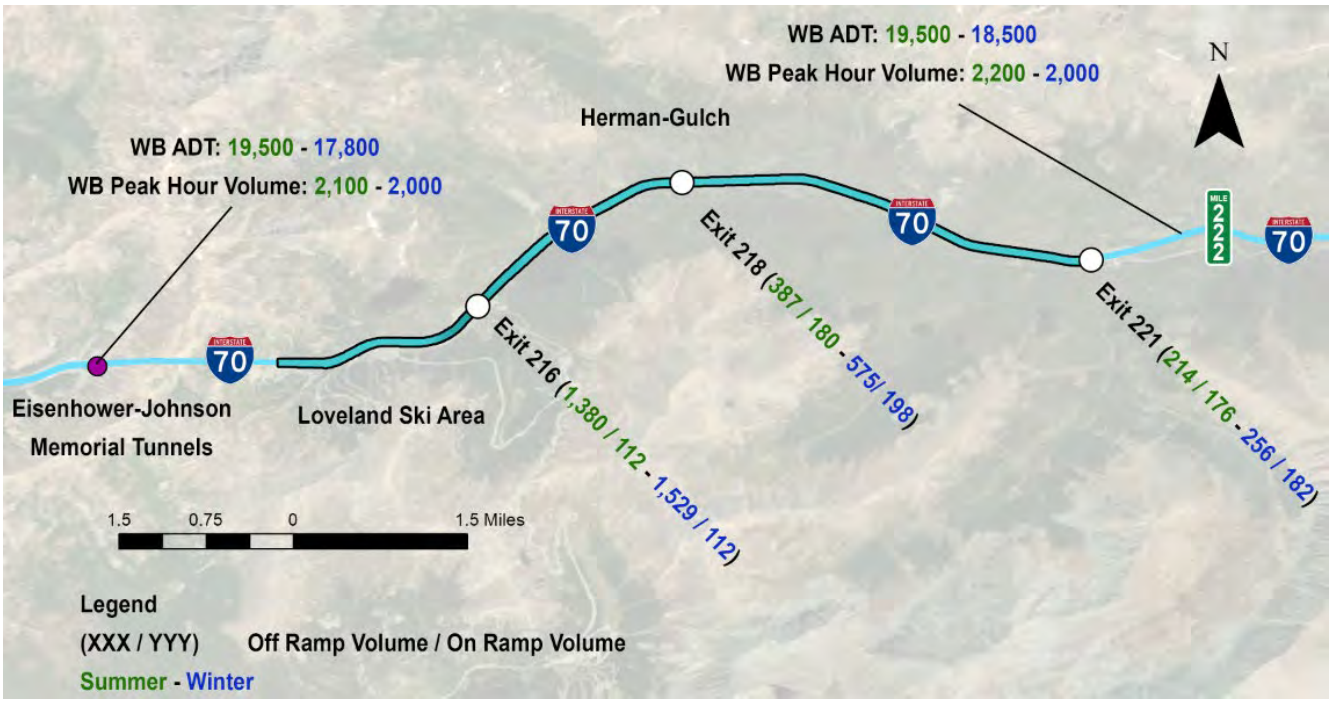
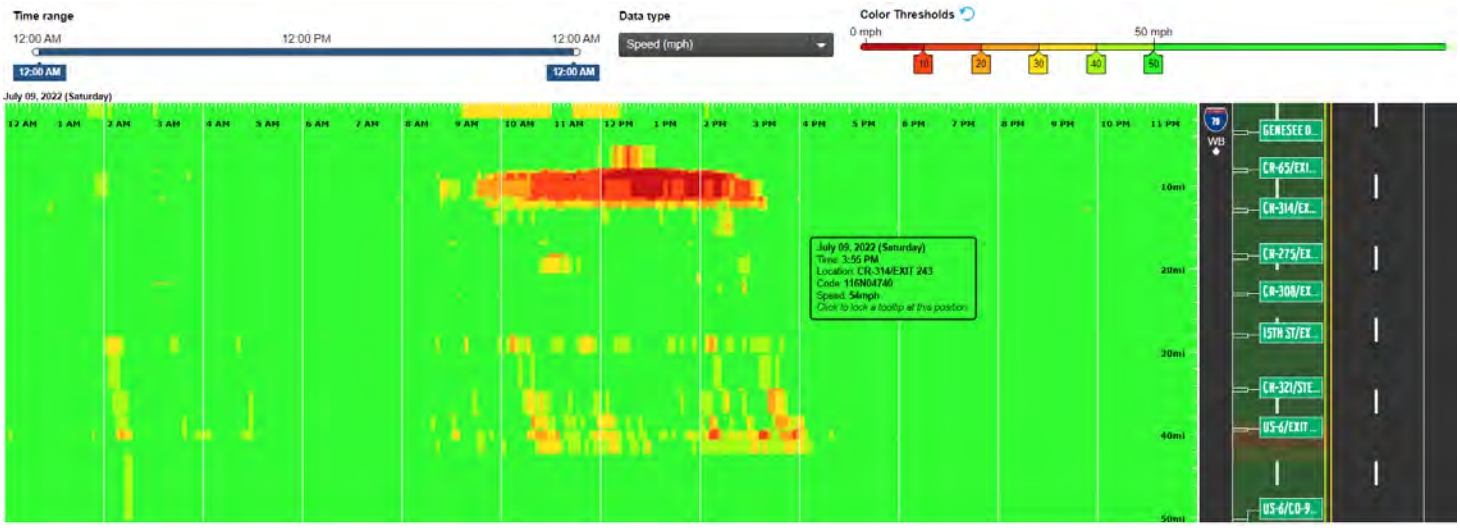


Figure 78. 2022 Winter and Summer Design Day Traffic Volumes

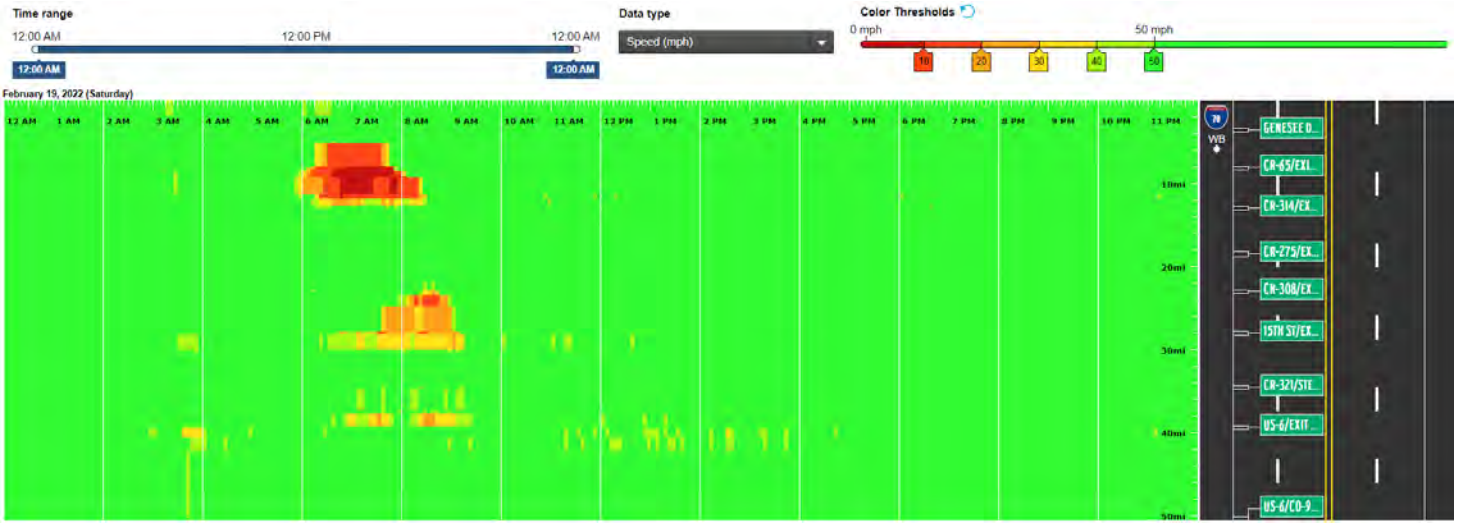
8.8 Design Day Congestion

Figure 79 and **Figure 80** show congestion for the summer and winter design days, respectively. **Figure 80** indicates that the winter congestion is heaviest between 6 AM and 8 AM around Floyd Hill, and from 7:30 AM to 9 AM through the PPSL segment. The study area for this project shows spot congestion near the US 6/Loveland Pass exit from 7 AM to 9 AM. **Figure 79** indicates that summer congestion persists at Floyd Hill from 9:30 AM to 3 PM, while congestion in the study area for this project is present from 10 AM to noon and again from 2 PM to 4 PM.



Source: INRIX Congestion Scan.

Figure 79. I-70 WB Congestion on July 09, 2022



Source: INRIX Congestion Scan.

Figure 80. I-70 WB Congestion on Feb 19, 2022

8.9 ITS Devices

ITS infrastructure is critical for informing the traveling public in this section of I-70 because of the terrain and variable weather conditions. CDOT's fiber trunk line runs along the north side of the study area, adjacent to pavement. The current inventory of ITS in the project study area includes variable speed limit (VSL) signs, overhead variable message sign (VMS), weather stations, one traffic camera, and one vehicle over-height sensor located approximately a quarter of mile east of the tunnel. **Figure 81** shows the current location of these structures in the project area.

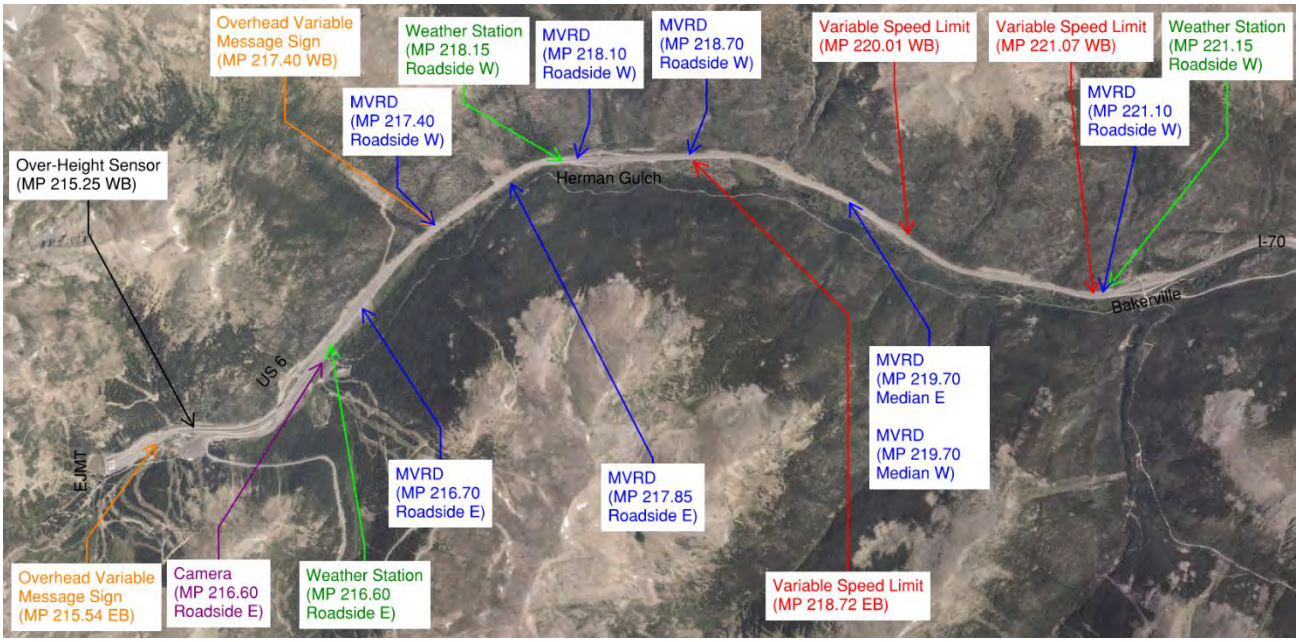


Figure 81. Existing ITS devices

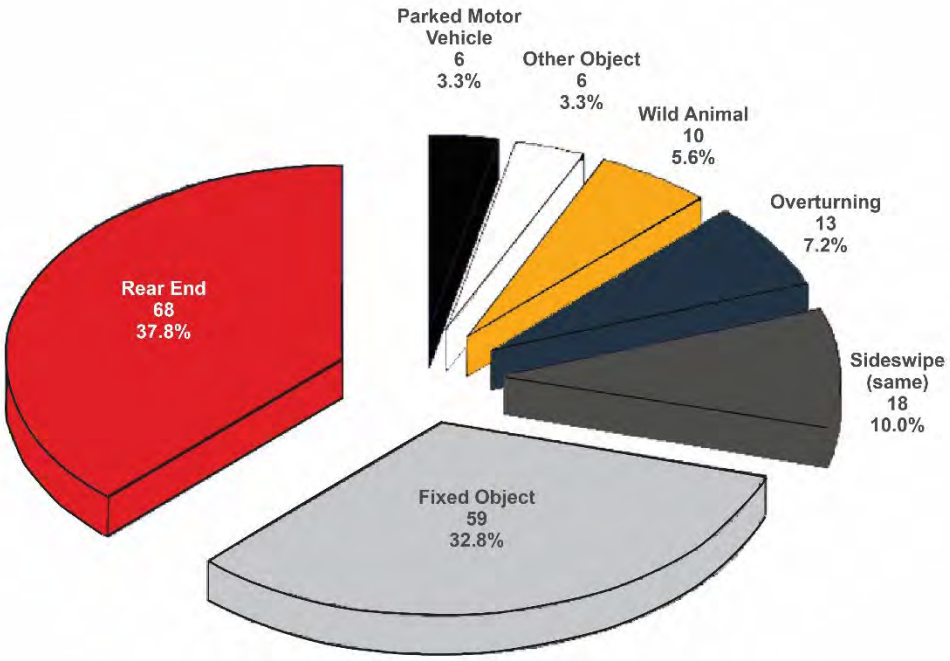
8.10 Safety Assessment

The following findings are taken from the *DRAFT Interstate 70 Directional Safety Assessment Report: MP 215.30 to MP 221.50 Bakerville Interchange to Eisenhower Tunnel East Portal* (DiExSys 2022; Appendix A). The safety assessment focused on crashes that occurred between January 1, 2015, and December 31, 2021 on westbound I-70 within the study area. All data reported here is for the WESTBOUND direction only.

8.10.1 Crash Patterns

A total of 180 crashes were reported in the westbound direction during the 6-year time period. This represents 37 percent of the 492 total crashes on the corridor (the balance was in the eastbound direction). Of these crashes, 73 percent were property damage-only crashes and 27 percent were injury or fatal crashes.

Figure 82 shows the distribution of WB crash types that occurred within the study area. The most predominant crash type was rear-ended collisions (38 percent), followed by fixed object collisions (33 percent) and sideswipe collisions (10 percent). Of the fixed object collisions, cable rail was the most common type of object struck, followed by embankment and guardrail.



(Source: *DRAFT I-70 Directional Safety Assessment Report: MP 215.30 to MP 221.50 Bakerville Interchange to Eisenhower Tunnel East Portal (DiExSys 2022))*

Figure 82. I-70 Mainline Crash Distribution by Type, MP 215.30 to MP 221.50 (WB Direction)

Crash pattern recognition identified a pattern of cable rail and embankment collisions for the segment between the EJMT and the Herman Gulch interchange. Crashes occurring during adverse winter road and weather conditions are also an identified pattern in that segment. For the segment between the Herman Gulch interchange and the Bakerville interchange, the crash pattern recognition identified a pattern of injury, multi-vehicle, rear-end, and cable rail crashes, as well as crashes occurring under winter road conditions.

8.10.2 Crash Locations

To facilitate a more detailed crash analysis, the 6-mile corridor was divided into two segments:

- Segment 1: Herman Gulch to EJMT – MP 218.38 to MP 215.30
- Segment 2: Bakerville to Herman Gulch– MP 221.50 to MP 218.39

Level of Service of Safety (LOSS) is calculated for both crash frequency and crash severity in each segment. The concept of LOSS uses qualitative measures that characterize safety of a roadway segment in reference to its expected performance. If the level of safety predicted represents a normal or expected number of crashes at a specific level of Average Daily Traffic, selected percentiles within the frequency distribution are stratified to represent specific LOSS.

- LOSS I—Indicates a low potential for crash reduction (below 20th percentile)
- LOSS II—Indicates a low to moderate potential for crash reduction (20th percentile to mean)
- LOSS III—Indicates a moderate to high potential for crash reduction (mean to 80th percentile)
- LOSS IV—Indicates a high potential for crash reduction (above 80th percentile)

For the WB frequency of crashes, both segments operate at LOSS II and thus have low to moderate potential for crash reduction.

For the severity of crashes, Segment 1 operates at LOSS II and thus has low to moderate potential for crash reduction, while Segment 2 operates at LOSS III and thus has a moderate to high potential for crash reduction.

9 AESTHETIC GUIDELINES

While evaluating the addition of a climbing lane to westbound I-70, design changes will consider all aesthetic principles set out by the core values in the I-70 Mountain Corridor Context Sensitive Solutions. Overall, the aesthetic principles are inspired by the surroundings, protect scenic integrity, and incorporate the context of place.

As a reference, aesthetic design treatments will:

- Support safety and mobility
- Support communities and regional destinations by providing direct and subliminal messaging for gateways, connections, access, and identification
- Maintain a sense of the greater whole
- Respect the current time and place
- Integrate with functional elements
- Borrow materials from the landscape
- Showcase key views while buffering inconsistent views
- Include maintenance considerations and responsibilities

9.1 Guardrail

Currently throughout the project limits, there exists types of guardrails that do not currently meet the I-70 Mountain Corridor Aesthetic Guidance for the Crest of the Rockies segment which the project falls into. As the design of the climbing lane progresses, consideration for impacting/replacing guardrail will be taken into consideration. As the guideline's state, the use of cable rail is strongly discouraged in this segment of the corridor because of the long-term maintenance cost and aesthetics. The use of Type 3 Guardrail W Beam with wooden posts are preferred for guardrails. Median barriers should only be considered where the median width or the vertical separation between east and west bound lanes cannot meet the Design Criteria.

Currently, the median guardrail features from MP 216 to MP 221 include concrete structural fixed guardrail, 3-strand cable rail, and blocked out W-beam. Sections of these safety features within the median and outside shoulder are subject to improvement.

9.2 Structures

The existing structures in the study area do not meet many of the design criteria presented in the Crest of the Rockies Aesthetic Guidance. The existing structures are of different designs, utilizing different materials, geometries, and features that do not promote visual continuity throughout the corridor. Some of the prominent deficiencies are:

- The approach and abutment embankments are at slopes steeper than those allowed by the earthwork guidelines
- The structures do not employ the correct color schemes or deliberate shadows
- Some of the structures have open abutments and appear cluttered underneath
- The structure guidelines recommend using box girder superstructures, which none of the bridges utilize

9.3 Rock Cuts & Modifications

Several methods of rock cuts have been utilized throughout the project limits. The existing rock cuts at the Bakerville exit occurred prior to the aesthetic guidelines being established. This area used a presplitting blasting technique that left vertical drill holes which is in disagreement with the guidelines. Any future rock cuts should

employ custom naturalize cuts and staggered benches and avoid the use of straight vertical cuts and benches that have a sheer, unnatural appearance. In addition, any rock cuts should use scatter blasting techniques and random rock drilling at varying depths to cause rock to break in natural patterns and expose natural rock fractures.

Other aspects of the aesthetic guidelines, other than the specific techniques for rock cutting that will be considered during the design process, is to evaluate moving the road away from the rock face to avoid rock fall protection. This may be difficult due to the narrow median width along the corridor.

10 RECOMMENDATIONS FROM THE EXISTING CONDITIONS REPORT

10.1 Changes within the Roadway Footprint

Due to substandard ramps, sight distance and alignment of US 6 interchange, it is highly recommended that the US interchange be relocated to the east. Moving the interchange east will allow removal of the loop on-ramp to WB I-70 which requires low speeds and a lack of acceleration length to get up to speed traveling uphill with I-70 climbing grades. Moving east will also provide greater sight distance around the mountain to the northwest, increasing reaction time for queues in the approach to EJMT. Numerous accidents occur EB where sight distance is hampered in the approach to US 6 and icing of the I-70 skewed structure over US 6 is common. Relocating the interchange to the east will improve sight distance for both WB and EB travel and will allow for a perpendicular bridge over US 6 resulting in less deck surface for icing.

Additional foreseeable changes along the roadway include the relocation of utilities and fiber optic. The underground fiber optic and electrical line that exist parallel to I-70 on the north side of the westbound lanes will be impacted in areas the climbing lane is added to the north. Coordination with the owners will be necessary and it is currently known that CDOT shares the fiber optic conduit with Comcast and Xcel Energy owns the electric lines. As the fiber optics approaches the Eisenhower Johnson Memorial Tunnel, relocation of the utilities will be evaluated as to avoid landslides or major rock cuts in non-stable areas.

10.2 Consideration of Risk and Resiliency

Due to the critical function of I-70 and being the only east-west continual corridor through Colorado that is heavily depended on for freight movement, preserving the function of the interstate is critical. Shifting US 6 to the east will allow for upgrading the ramps to standard lengths and avoids impacting the hillside in the approach to EJMT, thus avoiding a potential landslide area.

Increasing the height or length of the berm at the avalanche chute at MP 217.8 and installing detection and automatic launch devices could prevent a large avalanche from building and moving onto the interstate.

At MP 219.2, an increase in the culvert size under I-70 and adding a dissipation field for the debris flow at Watrous Gulch could help to mitigate debris from closing the interstate.

Two wildlife crossings near each end of the project, along with wildlife fence, will improve the safety for the traveling public and reduce vehicle and animal collisions that can close down the interstate.

10.3 Structures Recommendations

The following are Ulteig's preliminary recommendations for the 6 structures in the project limits based on the existing conditions.

F-13-O

The recommended action for structure F-13-O is replacement. To widen the structure, rehabilitation of the existing bridge deficiencies will need to be addressed. It is anticipated US Highway 6 will be realigned east of the current bridge location to intersect I-70 at a perpendicular angle. The replacement of F-13-O could also be combined with a replacement of F-13-P placing both westbound and eastbound I-70 onto one structure.

F-13-P

The recommended action for structure F-13-P is replacement. It is anticipated US Highway 6 will be realigned east of the current bridge location to intersect I-70 at a perpendicular angle. Additionally, given F-13-P's proximity to F-13-O, replacing F-13-O will require modifications to F-13-P since the structures share a deck joint, abutments, and traffic barriers. The replacement of F-13-P could also be combined with a replacement of F-13-O placing westbound and eastbound I-70 onto one structure.

F-13-J

The recommended action for structure F-13-J is replacement. To widen the structure, the poor condition of the existing deck needs to be addressed. The deck has widespread cracking, delamination, and efflorescence indicating the deck is at the end of its service life and should be replaced. For cast-in-place monolithic T-girders superstructures, girder shoring will be required to replace the deck. The girder shoring will require a prolonged closure of Herman Gulch Road. Replacing the bridge would not require the prolonged closures of Herman Gulch Road. Drainage west of the bridge needs to be addressed with rundowns to keep surface water from flowing onto the structure.

Additionally, the bridge is 50 years old and is near the end of its life cycle. Replacing the deck is necessary to widen the bridge but would be a large cost that would not extend the overall life of the structure.

F-13-L

The recommended action for structure F-13-L is replacement. The deck has widespread cracking, delamination, and efflorescence indicating the deck is at the end of its service life and should be replaced. For cast-in-place monolithic T-girders superstructures, girder shoring will be required to replace the deck. The girder shoring will require a prolonged closure of Herman Gulch Road. Replacing the bridge would not require the prolonged closures of Herman Gulch Road.

An additional alternative is to combine the replacement of F-13-J and F-13-L. If the widening of F-13-J is towards the median, the bridges will be in close proximity, and it may be viable to place westbound and eastbound I-70 onto one structure.

Additionally, the bridge is 50 years old and is near the end of its life cycle. Replacing the deck is necessary to widen the bridge but would be a large cost that would not extend the overall life of the structure.

F-13-T

Although this structure was not listed in the RFP, it is in the project limits and the field inspection shows a need for repairs. The recommended action for structure F-13-T is rehabilitation pending no action is required to correct section loss on corroded areas of the steel girders. The following maintenance items should be performed to extend the life of the structure and improve public safety:

- Replace the bridge rail with MASH compliant bridge rail including upgrading the approach rail transitions and end terminals
- Repair or replace the curbs on the bridge and approach slabs
- Repair the erosion underneath the approach slabs and install adequate drainage to mitigate further erosion
- Clean and paint all girders, cross frames and bearing plates
- Replace deformed elastomeric bearing pads
- Remove asphalt impacted into expansion joints
- Remove the existing, peeled concrete coatings on the abutments, wingwalls, curbs, and deck overhang and replace with new coating

It is understood that westbound structures F-13-O and F-13-J will need to be widened to accommodate the new climbing lane, but a comparative analysis between widening, rehabilitation, and replacement still needs to be performed to determine the best course of action.

Culvert 070A215590BL

The recommended action for structure 070A215590BL is rehabilitation. The following maintenance items should be performed to extend the life of the structure and improve its appearance:

- Patch the exposed reinforcement in the culvert headwalls and divider
- Clean and seal the construction joint near the culvert outlet
- Replace the tipping wingwalls at the culvert outlet
- Apply a colored concrete coating to improve the aesthetic appearance of the culvert

10.4 Safety Recommendations

The safety assessment recommends the following safety enhancements for the corridor:

- In general, a westbound climbing lane would contribute to improved operations along a corridor which experiences a notable amount of heavy commercial vehicle traffic on steeper grades. As such, any widening efforts would improve safety as it applies to all traffic.
- A flow and weather based VSL system in both WB and EB direction will have the potential to meaningfully improve safety.
- Added stalls, improvement in signage and acceleration/deceleration lanes into chain-up stations would prevent mile long queues and delays due to commercial vehicles looking for open stalls or pulling in or out of traffic.

Appendix A
Safety Study

Appendix B
Observed Traffic Counts