

## C.8. Tunnels Technical Plan

### C.8.1. Introduction

Tunnels are significant financial investments and critical links for intrastate and interstate travel. Tunnels are CDOT's third most valuable asset behind the state's pavement and bridge assets and are valued at \$1.8 billion (CDOT 2016 asset value study). There are 39 tunnels on the National Bridge and Tunnel Inventory in Colorado. There are nine off system, 10 closed tunnels and 20 CDOT on-system tunnels that meet the federal definition of a tunnel. Historically, CDOT considered snow sheds as tunnels but they do not meet the relatively new federal definition of a tunnel.

CDOT's oldest tunnel is Mishawaka on SH 14 built in 1929 and the newest are Veterans Memorial on I-70 near Idaho Springs which were built in 2015. The Eisenhower Johnson Memorial Tunnel (EJMT) is the highest vehicular tunnel in the world at an average elevation of 11,112 feet.

CDOT Division of Maintenance and Operations with Staff Bridge Branch manages the asset management program for the 20 on-system tunnel bores (6.9 miles of tunnel) throughout the State. Staff Bridge manages the federal inspection requirements and inventory. The Division of Maintenance and Operations role is asset investment and project selection. The Region Transportation Directors role is project delivery and tunnel operations.

Tunnel operations at the complex (manned) tunnels are funded through CDOT Maintenance Level of Service (MLOS) budgets. Four of these tunnel bores are complex, meaning they have a complex operating system and full-time staff monitoring critical systems. The manned bores are the EJMT and Hanging Lake Tunnels (HLT) and they represent about 70 percent of the state's total tunnel length.

### C.8.2. Regulatory Considerations

#### C.8.2.1. Regulations/Resolutions/Guidance

There are numerous regulations for tunnels for day to day operation from drinking water to high voltage electrical codes. The following list provides an overview of relevant federal and state regulations and requirements that influence planning.

- [23 USC 144, National Bridge and Tunnel Inventory and Inspection Standards](#)
- [23 CFR 650, National Tunnel Inspection Standards](#)
- [Essential Repair Directive Policy Memo](#)
- Colorado Revised Statutes (CRS) [43-1-106 \(8\) \(h\)](#), and [43-10-109](#)
- Policy Directive [14](#) and 1608.2
- Guide for the Preservation of Highway Tunnel Systems, NCHRP Report 816, March 2019 Final

### C.8.3. Asset Inventory & Condition

#### C.8.3.1. Asset Inventory

CDOT’s tunnel asset inventory is updated with condition information in accordance with the National Tunnel Inspection Specifications (NTIS) established under 23 CFR 650. Inspections are performed by a multidisciplinary team and include geotechnical structure, structural elements, tunnel systems, and life safety components. Tunnel condition surveys and inspections are performed every 24 months. Tunnel elements are defined in the NTIS and the Colorado Supplement and are managed by Staff Bridge. Inventory, and condition data is reported to FHWA annual which is similar to the National Bridge Inspection program. The tunnel inspection data is based on a 1-4 scale. (1) Good, (2) Fair, (3) Poor and (4) Warrants Review. Specific condition data from inspection is used in the Asset Investment model.

**Table 3 Colorado Tunnel Inventory**

Tunnel Number	Tunnel Name	Year Built	Annual Average Daily Traffic
F-13-Y	Eisenhower Tunnel	1973	29000
F-13-X	Johnson Tunnel	1979	29000
F-15-DM	Veterans Memorial (WB)	2015	49000
F-15-DN	Veterans Memorial (EB)	2015	49000
L-06-P	Bear Creek	1942	2200
N-09-F	Wolf Creek	2004	3200
F-07-Q	No Name (WB)	1965	15000
F-07-R	No Name (EB)	1965	15000
F-08-AT	Reverse Curve	1989	14000
F-15-AW	Clear Creek No. 3	1957	11000
F-15-AX	Clear Creek No. 2	1941	11000
F-15-AY	Clear Creak No. 1	1951	11000
F-15-X	Clear Creek No. 6	1939	4200
F-15-Y	Clear Creek No. 5	1939	4200
H-03-BT	Beavertail (WB)	1986	16000
H-03-BU	Beavertail (EB)	1986	16000
B-15-E	Mishawaka	1929	1200
D-15-AS	Boulder Canyon	1953	3900
F-08-AP	Hanging Lake (EB)	1992	14000
F-08-AQ	Hanging Lake (WB)	1992	14000

#### C.8.4. Asset Conditions

The tunnel conditions are documented in the Staff Bridge Inspection program. CDOT’s tunnels are in various stages of life and condition. The complex tunnels have systems that are aging. The Eisenhower tunnel is 40 years old and Hanging Lake Tunnel is 27 years old. The simple tunnels have less elements and are less expensive to maintain. The planned electrical system upgrade at the Eisenhower tunnel that started in 2006 is almost complete. The upgrade included electrical switches, transformers and motor and electrical control upgrades. Tunnel assets have spent



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millions in electrical replacements. Generally, tunnel conditions are trending up as poor elements have been replaced. CDOT has not accumulated many years of condition data. CDOT has focused investments on the asset in poorest condition, which has improved the overall system health over time.

### C.8.5. Performance

#### C.8.5.1. Metrics

A tunnel “element” is defined as a part of a tunnel system that is needed for the tunnel to function as intended. Tunnel elements include structural, civil, mechanical, electrical and lighting systems, fire/life/safety/security systems, signs, and protective systems. The Colorado Tunnel Inventory and Inspection Manual provides detailed descriptions of each element’s condition rating.

#### C.8.5.2. Targets

The performance targets are determined in PD 14. The aspirational performance target for tunnels is 100 percent of network tunnel length with all elements in equal or better condition than 2.5 weighted condition index. The fiscally constrained target is 80 percent. This initial target was established to stand up and establish the tunnel asset program. As the poor elements have been fixed, the overall target should be raised to better reflect investment.

### C.8.6. Funding

#### C.8.6.1. Funding Mechanisms

The tunnel program does not have a dedicated pool of funding for capital improvements. Funding pool Capital Tunnel Pool (CTP) and Inspection Tunnel Pool (BTP) are used to track expenses. The main sources of funding for the tunnel program are the State Highway Fund (SHF) and federal reimbursement for eligible expenditures. The SHF are in the state Maintenance and Operation budget in the MLOS 500 activities.

The following types of federal funding are eligible for tunnel inspections: National Highway Performance Program, Surface Transportation Program, and the Highway Safety Improvement Program. The Structures On-System fund provides for inspection and inventory of tunnels, management for all essential repairs and critical findings for the structural assets program, and annually required reporting to FHWA. The Structures On-Systems fund has an inspection and a capital construction allocation. The Structure Inspection and Management program includes inspection and management of tunnels as well as bridges, culverts, and walls. Tunnel construction projects are delivered by the Region in which a tunnel is located.

#### C.8.6.2. Region Pool Distributions

The Tunnel Program functions as a statewide program and does not have set regional distributions.

### C.8.7. Investment Strategies

Tunnel asset investment strategies center on lifecycle, condition, safety, tunnel operation, and operational experience. The investment strategy is based on AIMS model outputs and tunnel owner issues not identified in the tunnel model such as obsolesces.

### C.8.8. Lifecycle Management & Project Selection

The Guide for the Preservation of Highway Tunnel Systems, NCHRP Report 816, March 2019 Final, outline the Colorado lifecycle management process.

#### C.8.8.1. 7.1. Lifecycle Management

Lifecycle management is facilitated using AIMS. The process predicts the long-term performance of each asset given various investment scenarios. The tool allows CDOT to test the impact of different budget scenarios on tunnel asset lifecycles.

#### C.8.8.2. Treatment Lists

Common tunnel treatments include washing; maintenance of tunnel electrical, mechanical and ventilation systems; and structural maintenance and repair.

#### C.8.8.3. Project Selection

The project selection process utilizes AIMS and considers the significance that an investment will have in improving life cycle and safety as well as tunnel operation conditions. The asset management program strives to replace critical systems on a regular cycle in manned tunnels. The failure of some of these systems can result in fatalities to both the traveling public and to CDOT staff. The project selection process involves numerous parties including Asset Managers, OFMB and Region Business Office, Region Tunnel Maintenance, the Region Transportation Director (RTD) and the Region PE III among others. The process shows that data-driven needs are provided to Asset Managers who create project recommendations for consideration by Region Tunnel Maintenance, the Resident Engineer and the PE III. A final project list is provided by the Asset Manager to the RTD, assigned a budget and a project is created.

### C.8.9. Regions and Headquarter Roles

#### C.8.9.1. Region Roles

Tunnel managers have influence on the application of maintenance, project prioritization, and investment decisions. Managers recommend projects and assign funds across different treatment categories.

#### C.8.9.2. Headquarters Roles

CDOT headquarters develops asset need projections, provides leadership on project selection, works with Region Tunnel Asset budget requests and oversees transfer of funds from inspection to a capital improvement project.

## C.8.10. Reporting, Management, & Documentation

### C.8.10.1. Reporting to Internal and External Stakeholders

Inspection findings are reported following every tunnel inspection. The reports are submitted to the CDOT Tunnels Program manager. This process is described in the [Colorado Tunnel Inventory and Inspection Manual](#). Inspection reports are also prepared annually for FHWA. Condition data is used by the Performance and Asset Management Branch to report performance.

### C.8.11. Management / Advisory Committees

Key stakeholders having stakes in the performance of tunnels include:

- Transportation Commission
- Transportation Asset Management Oversight Committee – which provides oversight and strategic direction to CDOT’s Asset Management Program
- Transportation Asset Management Working Committee – which performs tactical work on various CDOT Asset Management initiatives.
- Tunnel Working Group – which is comprised of tunnel operators and engineers