I-70 Mountain Corridor PEIS Alternatives Development and Screening Technical Report

August 2010

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Section 1. Summary

1.1 What is in this Alternatives Development and Screening Technical Report?

This *Alternatives Development and Screening Technical Report* provides supporting documentation for the *I-70 Mountain Corridor Programmatic Environmental Impact Statement* (PEIS). Chapter 2 of the PEIS summarizes the evaluation process that led to the development and screening of alternatives resulting in a reasonable range of alternatives, and the identification of the Preferred Alternative.

A primary challenge for the I-70 Mountain Corridor is developing transportation alternatives that meet the project needs, accommodate projected travel demand, improve safety, and can be implemented within the environmental sensitivity and community values contexts of the Corridor setting. This Technical Report describes the chronology and key factors that initiated the development and evaluation of alternatives. This report documents the process and results of the three levels of screening leading to the development of the 21 Action Alternatives, including the Preferred Alternative, evaluated in the PEIS and explains how the components of the alternatives are included in the Preferred Alternative. Development and evaluation of alternatives, and elements of the alternatives, occurred during the early stages of the project from 2000 to mid-2003. These initial planning stages documented the development of alternatives, evaluation criteria, analyses, and results. As alternative development progressed, criteria was modified at each level of screening to incorporate updated analyses and develop alternative elements presenting the best opportunity to meet purpose and need.

The first section of this report, the **Summary,** is presented in a Question and Answer format, and is followed by **Section 2**—Overview of Alternatives Development, Evaluation and Screening Process, **Section 3**—Public and Agency Involvement in Alternatives Evaluation, **Section 4**—Alternative Evaluation and Screening, and **Section 5**—PEIS Alternatives.

1.2 What were the key considerations that influenced the development of alternatives?

The key considerations influencing the development of alternatives and the evaluation process are illustrated on **Figure 1** and include:

- Role of the *I-70 Corridor Major Investment Study* (CH2M HILL, 1998)
- Unique Corridor travel demand characteristics and transportation demand model requirements
- Problem areas of corridor capacity, congestion, and safety concerns
- Introduction of fixed-guideway transit into the I-70 Mountain Corridor
- Other related transit technology development studies
- Length and context of the I-70 Mountain Corridor
- Crossing the Continental Divide
- Tunnel requirements
- Corridor setting
- Historic context
- Proximity to creeks and rivers
- Indirect impacts and induced growth
- Application of evaluation criteria

Each of these considerations is described below.

Role of the I-70 Corridor Major Investment Study (CH2M HILL, 1998). The *I-70 Corridor Major Investment Study* was the starting point for the initial development of alternatives for the I-70 Mountain Corridor. The 50-year Corridor Vision in the *I-70 Corridor Major Investment Study* identifies a multimodal transportation system for the Corridor that includes the following transportation improvements:

- Transportation management
- Localized highway improvements
- Fixed-guideway transit
- Rubber tire transit
- Highway
- Alternate routes
- Aviation

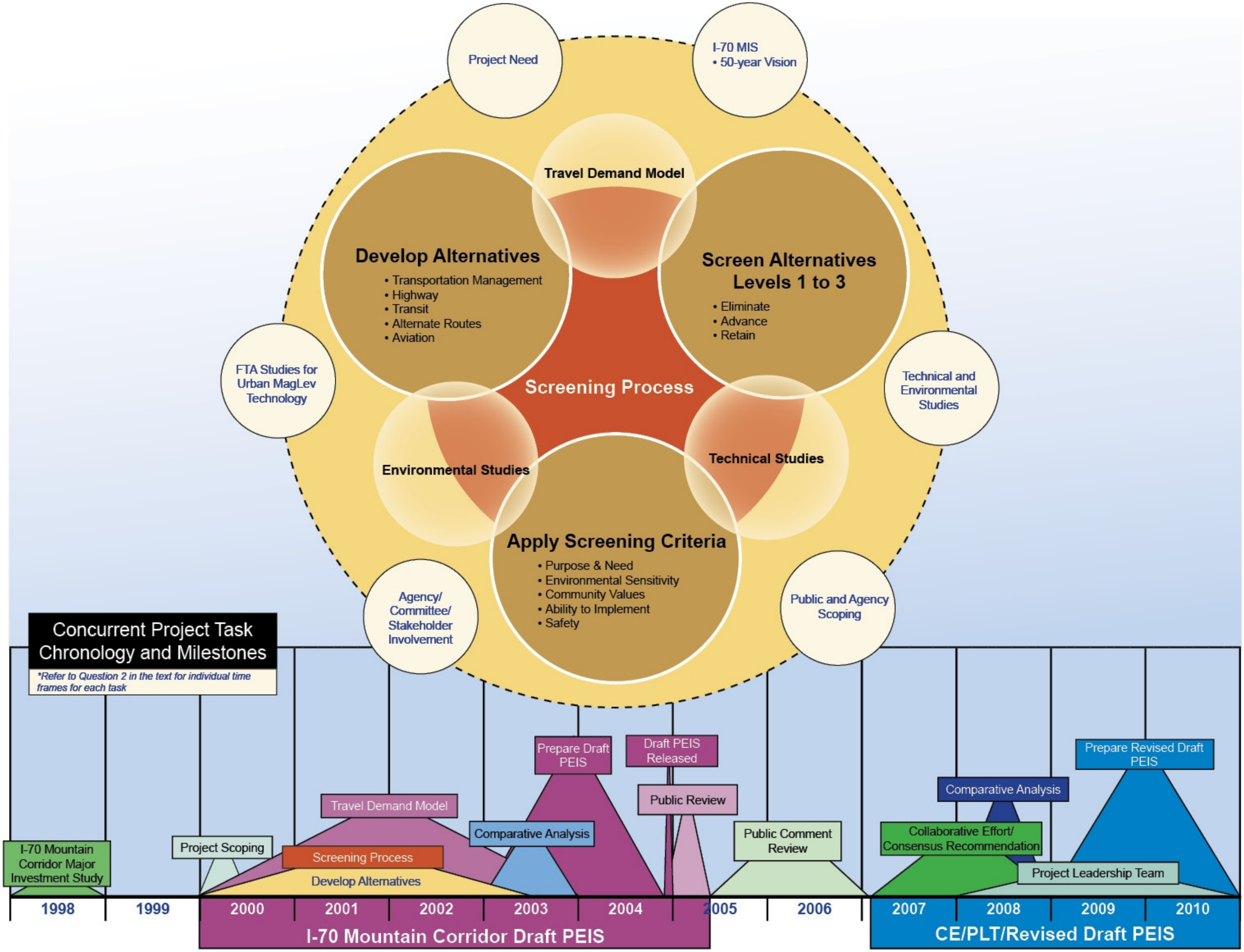
These transportation improvements provide the starting point for developing alternatives as alternative element families for the PEIS. These improvements also establish the foundation for the families of alternative elements examined for the Corridor. Tunnels were identified as elements of alternatives based on design criteria and project need.

Unique Corridor travel demand characteristics and transportation demand model requirements. No comprehensive Corridor-wide travel demand model existed for forecasting future person trips. The lack of an existing Corridor-wide travel demand model required the development of a new travel demand model for the I-70 Mountain Corridor encompassing the range of trip purposes in the Corridor, including recreation demand. Typical metropolitan area travel demand models exclude recreation demand as an integral and dominant part of future travel demand. No comparable travel demand models exist in the United States or other countries that could be used for comparative analysis. Most models focus on urban peak-hour work trips. The initial development of the Corridor travel demand model incorporated direction from an expert peer review panel, user surveys, and a ridership survey to assess the use of Transit alternatives and the potential distribution of trips among travel modes (also called mode share). The resulting 2025 travel demand forecast provided the basis for evaluating the ability of alternatives to meet the project purpose and need in the screening process. In 2009, the Corridor travel demand model was modified to reflect 2035 demand and projected demand in 2050. The 2035 and 2050 estimates use updated socioeconomic forecasts to estimate trip demand. The desire was to produce a range of values to reflect potential uncertainty in the projection and provide for a reasonable range of growth assumptions appropriate at this first tier study. The *I-70 Mountain Corridor PEIS Travel Demand Forecast Technical Report* (CDOT, August 2010) contains details about the travel demand projections.

Problem areas of corridor capacity, congestion and safety concerns. Locations in the Corridor were identified for capacity deficiencies, congestion, and safety concerns. These include 26 interchanges, four curve safety areas, 12 miles of steep grades over 6 percent on mountain passes and long incline areas, and a 46-mile area of congestion from the west portals of the Eisenhower-Johnson Memorial Tunnels to C-470.

Introduction of fixed-guideway transit into the I-70 Mountain Corridor. With no current fixed guideway or rail systems operating in comparable conditions, another challenge was the development of representative Advanced Guideway System and rail technologies that could operate in the mountain conditions of the Corridor with 7 percent grades and sharp curves. The tight canyon corridors and the mountainous terrain of the Corridor greatly limited the ability to consider transit alternatives outside the I-70 Corridor that meet the needs of the Corridor.

Figure 1. Screening Process - Key Factors to Alternatives Development



Other related transit technology development studies. Colorado Department of Transportation coordinated and shared information with the Colorado Fixed Guideway Authority, and later the Federal Transit Administration (FTA) Colorado Urban Maglev program regarding Advanced Guideway System development and characterization studies. These consultations resulted in an evolving development of Advanced Guideway System concepts for the PEIS. The resulting FTA Urban Maglev System used in the PEIS is representative of the Advanced Guideway System technology.

Length and context of the I-70 Mountain Corridor. The overall context of the 144-mile study Corridor includes two National Forests, nine counties, three major watersheds, and more than 30 towns. These multiple jurisdictions required extensive agency and stakeholder involvement and the tracking and evaluation of a large number of complex and diverse issues in the development and evaluation of elements and alternatives. This process engaged six cooperating agencies and several stakeholder committees.

Crossing the Continental Divide. A major challenge for the Transit alternatives and some of the Highway alternatives is crossing the Continental Divide. These crossings require construction of one or two new bores in the vicinity of the Eisenhower-Johnson Memorial Tunnels. None of the various concepts to avoid a new bore(s) at Eisenhower-Johnson Memorial Tunnels is technically viable: expanding the existing tunnels, a new alignment over the Continental Divide, or a new alignment over Loveland Pass (referred to as the Snake Creek alignment).

Tunnel requirements. The mountainous terrain and tight canyon corridors along the I-70 highway require additional tunnel improvements at the existing Continental Divide (Eisenhower-Johnson Memorial Tunnels) and the Twin Tunnels. Other tunnel locations studied include Dowd Canyon, Georgetown Incline, and the Floyd Hill area. Tunnels were added to the evaluation as an alternative element to support transit and highway alternatives during Level 2 screening. Tunnels are costly to construct and maintain and can result in unacceptable environmental impacts.

Corridor setting. The setting of the Corridor encompasses unique environmental, socioeconomic, and cultural resource values within mountainous topography, requiring context sensitive solutions for transportation improvements. The lack of existing transportation technologies that could operate within the Corridor setting and topographic constraints presents technical challenges to overcome.

Historic context. The Corridor is the home of several historic towns and the Georgetown Silver Plume National Historic Landmark District.

Proximity to creeks and rivers. The majority of the Corridor is along creeks and rivers, including the Colorado River, Eagle River, Black Gore Creek, Tenmile Creek, Blue River crossing, Straight Creek, Clear Creek, and Mount Vernon Creek. Water quality impacts must be examined when constructing adjacent to waterways.

Indirect impacts and induced growth. The Environmental Protection Agency identified concerns for the indirect impacts resulting from induced growth in the Corridor as a result of increased capacity and the introduction of transit into the Corridor. These concerns require a travel demand model sensitive to increased capacity and travel demand, which is not typically addressed in a travel demand model. These concerns require additional evaluation techniques to identify the effect of induced travel demand.

Application of evaluation criteria. Decisions for screening alternatives involve the use of criteria responsive to both the project purpose and need and agency and public input. The project needs are based on understanding the transportation problems and the future demands of the I-70 Mountain Corridor. Alternatives are developed and evaluated based on the ability to address the project needs while considering the criteria of environmental sensitivity, community values, transportation safety, and ability to implement. The lead agencies used evaluation criteria data to determine which transportation families and elements within families to retain for evaluation in the PEIS.

The process to identify potential transportation improvements started with the Corridor Vision in the *I-70 Corridor Major Investment Study* (CH2M HILL, 1998). The project team used the *I-70 Corridor Major Investment Study* Corridor Vision and the information and suggestions identified through the PEIS public scoping process to initiate the development of alternatives. A systematic evaluation process with public and agency input led to the development of alternatives. Alternatives consist of various elements based on seven alternative element families. Each alternative element addresses either specific needs in the Corridor or corridor-wide issues. Each family of elements provides relative advantages or disadvantages relative to the project purpose and need. For example, some do a better job at improving capacity while others enhance mobility and accessibility. Alternatives fully evaluated in the PEIS emerged from the evaluation and screening process and formed the basis for identifying the transportation components of the Preferred Alternative.

The following are key project milestones from initial public scoping through the preparation of the Revised Draft PEIS:

- *I-70 Mountain Corridor Major Investment Study* (CH2M HILL, 1998)
- Project scoping—January 2000
- Project development and evaluation of alternatives—2000 to mid-2003
- I-70 user survey, ridership survey, and travel demand model development—2000 through 2003
- FTA Urban Maglev Technology Development, Colorado Maglev Project—2004
- Comparative analysis of No Action and 20 Action Alternatives—2003 to 2004
- Draft PEIS preparation—2003 to 2004
- I-70 Draft PEIS released—December 10, 2004
- Public review of Draft PEIS—December 10, 2004 to May 24, 2005
- Analysis of public comments and development of decision process—2005 to 2006
- Collaborative Effort—2006 to 2007
- Consensus Recommendation—mid-2007
- Comparative analysis of Consensus Recommendation—2008
- Project Leadership Team—2008—ongoing
- Preparation of Revised Draft PEIS—2009 to 2010

1.3 What is an alternative?

Alternatives represent a package of improvements considered to address the purpose and need for the Corridor. Improvements were initially evaluated as alternative elements, but once included as part of an Action Alternative became the components of that alternative. Alternatives are central to the PEIS tiered approach of evaluating a broad range of alternatives at Tier 1 and identifying a Preferred Alternative for Tier 2 implementation. There are several levels of screening involved in the development and evaluation of alternatives. The following vocabulary describes alternatives at the varying stages of development and evaluation:

- The transportation improvements of transportation management, localized highway improvements, fixed-guideway transit, rubber tire transit, highway, alternate routes, and aviation form the various "families" of alternative elements considered. Within each family, alternative elements were identified and evaluated for consideration.
- The term "alternative element" describes elements evaluated and eventually comprising the components within the 21 Action Alternatives. For example, the alternative elements of the

Highway family include the alignment, grades, curves, travel lanes, shoulders, median, interchanges, auxiliary lanes, and tunnels. The evaluation of each of these Highway Alternative elements involved multiple options, such as variable width shoulders, flex lanes, smart widening, interchange improvements, auxiliary lanes, movable median, curve safety modification, parallel routes, and tunnel capacity improvements.

- Within the transit family, various fixed guideway and rubber tire Transit Alternative elements are identified representing various system technologies. Different grades and alignments are considered to evaluate the capability and operability of transit technologies within the Corridor.
- Alternative elements advanced within each of the transportation families were ultimately "packaged" to create the components of single-mode and multimodal transit, highway and combination alternatives.
- Chapter 2 of the PEIS refers to "alternatives" as packages of improvement components combined to form a corridor-wide transportation solution.
- Documentation of the alternatives development and evaluation process includes various terminologies and provides context for their use in **Chapter 2** of the PEIS.

1.4 How does this Technical Report support the findings of Chapter 2?

Chapter 2 of the PEIS summarizes the evaluation and screening process and results, describes the transportation components for each Action Alternative, and provides a comparative analysis of alternatives. This comparative analysis includes the No Action Alternative and 21 Action Alternatives, including the Preferred Alternative. This Technical Report documents and details how each alternative was developed, the criteria applied in the screening process, and the packaging of alternatives for inclusion in the PEIS.

1.5 What were the roles of the three levels of screening?

The combined Level 1 through Level 3 screening process resulted in a range of reasonable alternatives evaluated in the PEIS. The alternative elements that were advanced from Level 1 and Level 2 screening were further refined and packaged into the components representing the Action Alternatives. The transportation components included in these packages are representative of the types of systems or improvements at this Tier 1 level of detail that meets purpose and need. The Preferred Alternative was identified through the Collaborative Effort process and is the 22nd Alternative.

1.5.1 Level 1 Screening

The initial review of alternative elements within each family was broad in concept and focused on identifying elements that addressed reduction of congestion, improvement of mobility, accessibility, and safety. Specific evaluation criteria were developed for the seven alternative element families. Level 1 screening followed project scoping and was completed in late 2000.

1.5.2 Level 2 Screening

The Level 2 screening built on the first level by providing a more in-depth analysis of capacity, mobility and accessibility, and incorporated criteria related to implementation (cost, constructability, and technology), environmental sensitivity, and community values. A train performance calculator model was used to simulate train performance over three different I-70 highway grade alignments (Highway—7 percent, 6 percent, and 4 percent grades) from Vail to C-470. The model was used as a key screening tool to verify the capabilities of various transit technologies on mountain grades. Level 2 screening was completed in late 2001.

1.5.3 Level 3 Screening

Following the conclusion of Level 2 screening, Level 3 screening refined advanced alternative elements and created multimodal transportation packages.

Twenty-one Action Alternatives were developed for evaluation in the PEIS as a reasonable range of alternatives. The 21 alternatives include the Preferred Alternative, which was developed including components of the other Action Alternatives and is also evaluated in the PEIS (see **Section 5** of this Technical Report for a description of the PEIS Alternatives). A No Action Alternative was also considered in the PEIS. Level 3 screening was completed in mid-2003.

1.6 Do alternatives accommodate the 2050 travel demand projections identified in the purpose and need?

Network capacity is reached when average Corridor traffic speeds are reduced to 30 miles per hour, resulting in stop-and-go traffic congestion (or Level of Service F). The following list ranks alternatives for the year in which the Corridor reaches network capacity and no longer accommodates growth in travel demand:

- With no transportation improvements, the Corridor reaches capacity in 2010 under the No Action Alternative.
- With the Minimal Action Alternative, the Corridor reaches capacity in 2015.
- The Highway and Transit alternatives accommodate growth in travel demand to about 2030, resulting in short-term capacity improvements for the Corridor.
- With the four Combination Six-Lane Highway with Transit alternatives, the Corridor reaches network capacity between 2045 and 2050.
- The Preferred Alternative accommodates a range of travel demand growth from 2030 to 2050. The maximum program of improvements accommodates Corridor growth in travel demand to 2050. Under the minimum program of improvements, the Corridor reaches network capacity around 2035.

1.7 What documentation supports the evaluation and screening of the various alternative elements?

Changes occurred in analysis approaches, evaluation criteria, and ongoing research through the evaluation process. At different points in time, new information was presented that fine-tuned the analysis and reflected changing circumstances as alternative elements were developed, refined, and evaluated. This Technical Report explains the following types of changes and provides final documentation of the alternatives evaluation process:

- Changes in assumptions for transit technologies, operating plans, and the termini of alternatives influenced capacity estimates, station assumption, and cost estimates.
- Rubber Tire Transit alternative elements initially eliminated through the screening process were later retained to broaden the range of alternatives for Tier 2 consideration.
- Selected tunnel alternatives initially eliminated through the screening process were later retained to broaden the tunneling options for Tier 2 consideration in topographically constrained or environmentally sensitive locations.

Evolving recommendations for screening of various Transit Alternative elements occurred during Level 2 screening to provide continued consideration for alternative elements showing promise under some evaluation criteria. For example, during the Level 2 screening process some of the initial findings were:

- All Single-Track Rail Alternative elements were eliminated because single-track elements did not have adequate capacity.
- In contrast to the Electric Rail Alternative elements, Diesel Rail Alternative elements performed poorly or not at all on the 6 percent alignment. However, due to advantages in connectivity opportunities with other systems and fuel availability, Diesel Rail alternatives were retained for consideration on a lower cost single-track 4 percent alignment for continued study.
- Conversely, Electric Rail Alternative elements performed equally well at 6 percent or 4 percent grades, so due to tunneling costs, all Electric Rail Alternative elements on 4 percent grades were eliminated.
- Light Rail Transit systems have the lowest capacity, but have the fastest speed among the Rail Alternative elements on all grades including highway at 7 percent. Light Rail Transit systems are among the least expensive systems, and could theoretically share a lane through the existing Eisenhower-Johnson Memorial Tunnels. Therefore the low-capacity LRT double-track was retained for further consideration in Tier 2.
- Eventually, the 4 percent alignment for all technologies was eliminated due to tunnel costs and off- Corridor alignment impacts; and all Single-Track Alternative elements were eliminated due to low capacity (below the 2000 passengers per/hour).
- New information from agency studies of Advanced Guideway Systems refined Level 3 screening analyses.

Initially a 2025 travel demand model was utilized in the Level 2 and Level 3 screening processes. Updated 2035 travel demand projections were used to evaluate and compare alternatives and 2050 projections were applied to identify alternatives that meet a long- term project need.

Section 2. Overview of Alternatives Development, Evaluation and Screening Process

The development of alternatives for the I-70 Mountain Corridor PEIS began with the Corridor Vision in the *I-70 Mountain Corridor Major Investment Study* (CH2M HILL, 1998). This study identified a 50-year Corridor Vision and recommended consideration of transportation improvements covering a wide range of options in seven categories labeled “families.” Following the Major Investment Study, the I-70 Mountain Corridor PEIS was initiated in 2000 to take the recommendations from the Major Investment Study through the National Environmental Policy Act (NEPA) process and develop and evaluate transportation improvements in the Corridor. Input on the development and evaluation of alternatives was gathered through the NEPA public and agency scoping process and was an integral part of the process to evaluate transportation improvements that best meet the purpose and need for the project.

The purpose for transportation improvements in the I-70 Mountain Corridor is to increase capacity, improve accessibility and mobility, and decrease congestion for travel demand (projected to occur in 2035 as well as 2050) to destinations along the I-70 Mountain Corridor as well as interstate travel, while taking into account environmental sensitivity, community values, transportation safety, and the ability to implement proposed solutions for the Corridor. From this need and building on the Major Investment Study recommendations, alternatives were developed and evaluated to best address the problems in the Corridor.

Through the process, over 200 alternative elements were developed, evaluated, and screened resulting in the reasonable range of alternatives analyzed in the PEIS. The alternative elements were derived from the seven families from the Major Investment Study. Each of these elements went through a detailed evaluation process and was evaluated based on their ability to address the project purpose and need, and on how well they met environmental sensitivity, community values, transportation safety, and implementation criteria.

The seven alternative element families are:

- **Transportation Management.** Includes strategies for improving mobility and reducing congestion on the Corridor.
- **Localized Highway Improvements.** Includes interchange, curve safety modifications and auxiliary lanes on I-70.
- **Fixed-Guideway Transit.** Represents rail transit.
- **Rubber Tire Transit.** Represents bus transit.
- **Highway.** Involves widening or other alterations to the roadway to provide capacity, reduce congestion and improve mobility and safety.
- **Alternate Routes.** Includes other transportation facilities between cities along the Front Range and destinations currently served by the I-70 highway.
- **Aviation.** Represents improvements to existing airport service and addition of new airports.

Tunnels were considered in some cases separately and others as required per design criteria associated with Highway and Transit Alternative elements because they are major infrastructure projects that apply to Highway and Transit families. Tunnels require large investments of money, engineering, special construction techniques, and have a lot of risk associated with them. Tunnels are generally avoided if feasible alternatives exist.

2.1 Evaluation Process

The evaluation process involved three levels of screening at increasing levels of detail. Alternative elements were evaluated on their ability to meet the purpose and need for the project, balanced with transportation safety, environmental sensitivity, community values, and ability to implement. During screening, alternative elements that did not meet the purpose and need and evaluation criteria were eliminated. Alternative elements that met the purpose and need and evaluation criteria were advanced for analysis in the PEIS. Evaluation criteria were used to systematically narrow the range of alternative elements at Level 1, and focus on the alternative elements that showed promise with more detailed studies at Level 2. The role of Level 3 screening refined the remaining alternative elements, finalized screening, and created packages of Action Alternatives for inclusion in the PEIS. The screening process satisfies the requirements of 40 Code of Federal Regulations 1502.14 (a) that states: “Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.”

The evaluation and screening process included the input of agencies, committees, stakeholders, and technical evaluation by the project team. The three levels of screening were:

- **Level 1.** Screening studies were broad in concept and focused on identifying alternative elements that addressed the project needs to increase capacity, improve accessibility and mobility, as well as decrease congestion. Safety criterion was included at this level because of the interrelationship between safety, mobility, accessibility, and congestion. At this stage, alternatives were conceptual, and evaluation was based on the suitability of technology and mode, rather than location and design. Therefore, ability to implement environmental and community value criteria were not applied. Level 1 screening studies were completed in late 2000.
- **Level 2.** Screening studies built on Level 1 and included a greater depth of analysis for alternative elements addressing capacity, mobility, accessibility, congestion, and safety. Level 2 screening incorporated qualitative and quantitative criteria related to implementation (cost, technology, and

construction constraints), environmental sensitivity, and community values. General location and design concepts were evaluated at this stage. Level 2 screening studies were completed in late 2001.

- **Level 3.** Screening studies focused on the refinement of alternative elements remaining after Level 2 screening and their reasonableness for use in the Corridor. This screening resulted in the elimination of some alternative elements while others advanced for evaluation in the PEIS. Some elements were retained for consideration in Tier 2, but were not evaluated in the PEIS. More detailed design considerations were developed to qualitatively assess ability to implement alternative alignments, environmental and community impacts, and travel demand performance. At this level, representative improvements were grouped by similar characteristics for analysis in the PEIS. Level 3 screening studies were completed in mid-2003.

The screening process is illustrated in **Figure 2**.

2.1.1 Evaluation Criteria

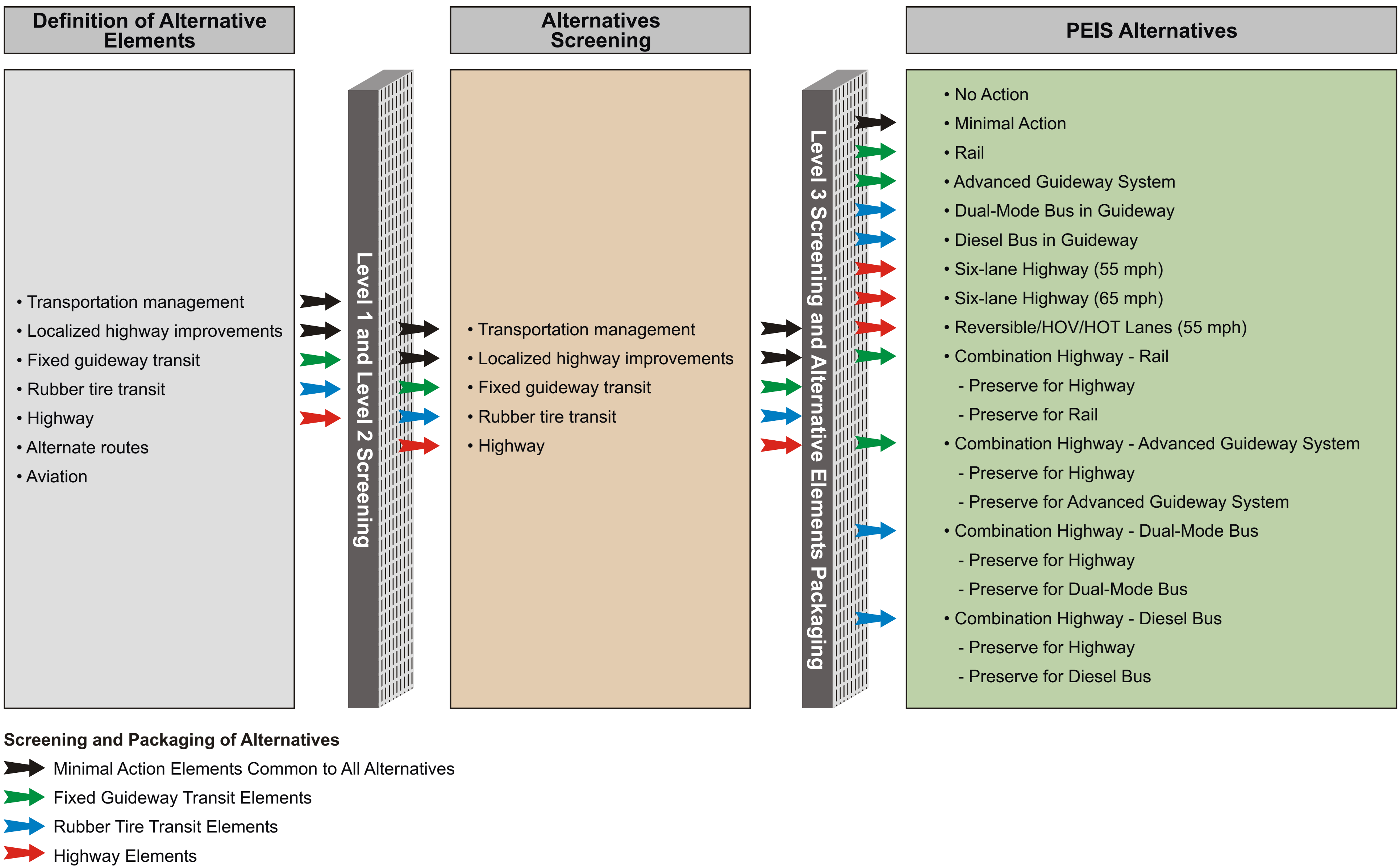
General evaluation criteria were developed for each of the three levels of screening, followed by more specific criteria for evaluating alternative elements within each family. Level 1 screening applied broad criteria narrowing the range of alternative elements to those that showed promise in meeting the purpose and need. More detailed criteria were then applied to the remaining alternative elements in Level 2. Alternative elements were refined and screening was finalized through interdisciplinary planning studies at Level 3, and packages of Action Alternatives were created for inclusion in the PEIS. General criteria established for each level of screening and approaches are summarized below.

Level 1 General Evaluation Criteria

The project needs addressed in the first level of screening are capacity and mobility. Safety is also a consideration at this level.

- **Capacity.** Addresses the impacts to the extent and duration of existing and future traffic congestion on the Corridor. For the first level screening, alternative elements must have sufficient capacity to meaningful reduce congestion, either in number of vehicles removed from the I-70 highway, or by measurably shortening the length of congested periods.
- **Mobility.** Addresses the potential and actual movement of people and goods within the Corridor.
- **Safety.** Addresses the conformance of the proposed alternative elements of each family to industry safety standards, the probability of vehicle crashes, and the passenger injury rate per mile traveled.

Figure 2. Alternatives Screening Process



mph = Miles per Hour

Note: See Section 2.5 for more screening details.

Level 2 General Evaluation Criteria

The goals of the Level 2 screening were to evaluate alternative elements based on criteria that address the project needs of capacity, mobility, accessibility, and congestion, while considering implementation, environmental sensitivity, and community values. Safety was used as an evaluation criterion. Implementation includes cost, technology, construction constraints, and fuel and energy consumption for Transit Alternative elements. Environmental criteria were established to evaluate, screen, and systematically narrow the range of alternatives considered in the PEIS, including consideration of Section 404 (b)(1) of the Clean Water Act and Section 4(f) provisions of the 1966 Department of Transportation Act.

Level 2 screening involved a more in-depth analysis using more specific evaluation criteria for the different modes of travel. Level 2 screening techniques included the use of a geographic information system (GIS) database, spatial analysis, and TransCAD and VISSIM as tools for mobility and congestion analysis.

Level 2 screening examined closely the performance elements of the fixed-guideway Transit Alternative elements; Rubber Tire Transit Alternative elements for diesel and electric power units, single-track and double-track facilities; and 4 percent grade, 6 percent grade, and highway (7 percent) grade alignments. Analysis of the Highway Alternative elements included the evaluation of mobility, accessibility, and reduction of congestion on its own merits. Safety was evaluated on how well alternative elements address safety concerns at the problematic areas. For both the Transit and Highway Alternative elements, the evaluation criteria for cost and constructability were evaluated as the ability to implement. The preliminary assessment of these criteria, coupled with engineering judgment, allowed an initial determination of how each alternative element fared in its reasonableness and practicability.

During Level 2 screening, evaluation criteria were included for selected environmental receptors and community value issues as part of the screening process. Some of the alternative elements in the family were eliminated because of the potential for substantial environmental impacts due to the alignment or transit footprint. For other alternative elements, the environmental impacts contributed to eliminating an element, but the primary reason for elimination was not meeting the need for mobility, capacity, or reducing congestion during peak travel hours.

Assumptions used for the criteria are briefly summarized below:

- **Capacity.** How well does the alternative element provide the ridership and roadway or transit capacity to accommodate future demand?
- **Accessibility.** How well does the alternative element connect to local transportation systems and communities in the Corridor?
- **Mobility.** How well does the alternative element improve travel time and speed?
- **Congestion.** How well does the alternative element reduce congestion or remove vehicles from the I-70 highway during peak congestion periods?
- **Safety.** How well does the alternative element provide safety measures appropriate to each family of alternatives based on the weighted accident rate as compared to the statewide average?
- **Implementation.** Are alternative elements reasonable, practical, and feasible?
- **Environmental Sensitivity.** How well do the alternative elements avoid or minimize conflicts with environmental issues such as:
  - Water quality
  - Fishery resources
  - Wetlands

  - Wildlife
  - Waters of the United States
  - Geologic hazards
  - Threatened, endangered, and special status species
- **Community Values.** How well do the alternative elements avoid or minimize conflicts with issues identified by the public and agencies such as:
  - Land Use
  - Noise
  - Recreation
  - Historic and archaeological resources
  - Federal management and scenic features/views

Specific criteria were developed to provide a uniform and common performance basis to evaluate the elements within each alternative element family. The criteria used within each alternative element family are family-specific and were not intended to compare the differences between families. The Level 2 screening process made extensive use of available data and mapping, a GIS database, and TransCAD and VISSIM modeling for mobility and congestion analysis.

The RAILSIM 7® Train Performance Calculator was used to model speed and energy consumption for exclusive right-of-way portions of Transit Alternative elements, including Rubber Tire Transit and Fixed-Guideway Transit systems.

Level 3 General Evaluation Criteria

The alternative elements retained after Level 2 screening were further analyzed to confirm their reasonableness for use in the Corridor. Level 3 studies conducted between late 2001 and early 2003 include alignment studies, technical analyses of cost and travel performance, and environmental impact assessment. Those alternative elements advanced for each family were "packaged" into alternatives for evaluation and comparison in the PEIS. During Level 3 screening, selected Transit, Highway, and Transportation Management Alternative elements were eliminated or advanced, and the remaining elements were packaged to become components of the Action Alternatives.

The studies conducted from late 2001 through early 2003 included:

- 4 percent and 6 percent grade alignment studies
- Technical (cost and travel performance) analyses
- Conceptual engineering
- Tunnel studies
- Environmental and community impact assessment
- Travel demand studies

Alternative design and alignment studies determined the technical feasibility of the alternatives to operate in the Corridor. Input from several committees, and agency and small group meetings, greatly assisted this stage of alternative analysis, resulting in the packaging of the Action Alternatives advanced for full analysis in the PEIS.

Section 3. Public and Agency Involvement in Alternatives Evaluation

Public and agency involvement activities were concurrent with the evaluation process, including meetings with the federal interdisciplinary team, the general public, Mountain Corridor Advisory Committee (MCAC), open houses, project website, and newsletters. The MCAC members included a cross section of people representing user and host organizations in the Corridor and selected representation from the counties, municipalities, community associations, special interest groups, and federal, state and local agencies. Public and agency involvement in the alternatives evaluation process included issue identification and review and input on methods, criteria, and results.

The results of each of the three levels of screening studies were documented in project newsletters, which were distributed to stakeholders interested in the Corridor:

- Volume 1—Number 2, published September 2000
- Volume 2—Number 1, published March 2001
- Volume 2—Number 2, published June 2001
- Volume 3—Number 1, published May 2003

Articles from these newsletters documenting screening results and the summary purpose and need were provided on the project website.

Input from several committees, agency meetings, and small group meetings greatly advanced the alternatives evaluation and screening process. Contributing organizations are listed below by category.

3.1 Committee Coordination

3.1.1 Historic Resources 4(f) and 6(f) Committee

The Colorado Department of Transportation formed the Historic Resources 4(f) and 6(f) Committee to provide interagency involvement in the identification and inventory of Section 4(f) and 6(f) properties within the Corridor. The Section 4(f) properties include public parks, recreation lands, wildlife and waterfowl refuges, and historic sites. The Section 6(f) properties are public park and recreation areas developed with assistance from the Land and Water Conservation Fund program. Agencies participating in this committee include:

- Advisory Council on Historic Preservation
- Colorado Commission of Indian Affairs
- Colorado Department of Transportation
- Federal Highway Administration
- National Park Service
- State Historic Preservation Officer
- United States Forest Service
- United States Bureau of Land Management

The consulting parties for Section 106 of the National Historic Preservation Act worked together to form the "I-70 Mountain Corridor Programmatic Agreement," designating how Tier 2 consultation on historic properties would be carried out. This Agreement, which was completed and signed in 2008, is available as **Appendix B** to the PEIS.

3.1.2 A Landscape Level Inventory of Valued Ecosystem Components (ALIVE) and Stream and Wetland Ecological Enhancement Program (SWEEP) Committees

The Colorado Department of Transportation formed the ALIVE Committee to develop an ecosystem approach at a landscape level to address wildlife and wildlife habitat issues in the Corridor. The tasks before the Committee were identification of wildlife habitat of high ecological integrity, wildlife habitat linkages, barriers to wildlife crossings along the I-70 highway, and mitigation strategies. An ALIVE Memorandum of Understanding was prepared and signed in 2008 by Federal Highway Administration, CDOT, United States Fish and Wildlife Service, United States Forest Service, United States Bureau of Land Management, and Colorado Department of Natural Resources, Division of Wildlife.

The Colorado Department of Transportation formed the SWEEP Committee as a way to identify and address environmental issues related to the improvement of wetlands, streams, and fisheries in the Corridor. The SWEEP program focuses on efforts to integrate water resource needs (such as water quality, fisheries, wetlands, and riparian areas) with design elements for construction activities and long-term maintenance and operations of the transportation system. The working group developed a Memorandum of Understanding among the lead agencies and the United States Fish and Wildlife Service, the United States Forest Service, the United States Bureau of Land Management, the Colorado Division of Wildlife, Clear Creek County, Clear Creek Watershed Foundation, Upper Clear Creek Watershed Association, Eagle River Watershed Council and Colorado Trout Unlimited.

3.1.3 Mountain Corridor Advisory Committee

The Colorado Department of Transportation formed the MCAC to receive input from diverse points of view. Members of the MCAC included a cross section of people representing the user and host organizations in the Corridor with selected representation from the counties, municipalities, community associations, and special interest groups. The members were selected through interviews based upon their knowledge of the area, willingness to participate in the working relationship, and ability to commit to the process. The committee met 17 times between June 2000 and April 2003 and participated in the process of developing and screening alternatives.

3.2 Agency Coordination

3.2.1 Federal Interdisciplinary Team

A Federal Interdisciplinary team was formed to gain a multiagency view of the needs of various federal agencies (and state agencies delegated responsibility for compliance with federal programs) and to provide a forum to understand the project from a larger viewpoint and policy perspective. The committee was composed of decision makers from federal and state agencies, who provided expertise relevant to the resources managed by their respective agencies. The team met at key milestones to review the findings of the alternative screening process, packaging of alternatives, impact analysis methods, and identification of early mitigation action. The team met between 2001 and 2004. The team membership included the following agencies:

- Advisory Council on Historic Preservation
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Federal Aviation Administration
- Federal Highway Administration
- Federal Railroad Administration
- Federal Transit Administration
- State Historic Preservation Officer
- United States Army Corps of Engineers
- United States Bureau of Land Management
- United States Forest Service
- United States Environmental Protection Agency
- United States Fish and Wildlife Service

3.2.2 Transit

These agencies and organizations provided assistance in the development of alternatives and data used in the preparation of the Travel Demand Model.

- Colorado Intermountain Fixed Guideway Authority
- FTA Colorado Urban Maglev Project
- Colorado Passenger Rail Association
- Colorado Association of Transit Agencies
- Colorado Motor Carriers Association
- ECO Transit
- Summit Stage
- Regional Transportation District

3.2.3 Planning Organizations

Meetings with these agencies and organizations assisted in providing data and suggestions for the land use studies included in the environmental components of Level 2 and Level 3 screening.

- Northwest Colorado Council of Governments
- Denver Regional Council of Governments
- Clear Creek County I-70 Task Force
- Nine counties in the Corridor study area: Garfield, Eagle, Pitkin, Summit, Lake, Park, Grand, Gilpin, Clear Creek, and Jefferson counties
- Municipal planners
- Elected officials

3.2.4 Water Resources, Historic Mining, and Water Quality Monitoring

These organizations participated in the scope and data for water resources studies, historic mining, and water quality monitoring programs. These studies were included in the environmental components of Level 2 and Level 3 screening.

- Upper Clear Creek Watershed Association
- Clear Creek Watershed Foundation
- Straight Creek and Black Gore Creek Steering Committees (Sediment Control Action Plan)

3.2.5 Travel Demand Peer Review Committee

Nationally recognized travel demand experts met on four occasions to review and critique the development of the Corridor travel demand-modeling program.

3.3 Level 1 Screening

Following is a summary of public and agency coordination that occurred during the Level 1 screening process from June 2000 to October 2000.

3.3.1 Mountain Corridor Advisory Committee Meetings

Three meetings were held between June and July 2000 addressing the following aspects of Level 1 screening:

- Families of alternatives
- Purpose and need

- Issues identification
- Screening results

3.3.2 Federal Interdisciplinary Team

Results of Level 1 screening were presented to the Federal Interdisciplinary Team in April 2001.

3.3.3 Public Open Houses

Eight public open houses were held throughout the Corridor between February 2000 and July 2000. The intent of these meetings was to introduce the public to the project, purpose and need, process, and potential alternatives to be analyzed in the PEIS and to solicit input on issues and alternatives.

3.3.4 Newsletters

The initial recommendations for Level 1 screening were published in the September 2000 newsletter, which was sent to the stakeholder mailing list.

3.4 Level 2 Screening

Following is a summary of public and agency coordination that occurred during the Level 2 screening process from November 2000 to August 2001.

3.4.1 Mountain Corridor Advisory Committee Meetings

Nine meetings were held between October 2000 and May 2001 addressing the following aspects of Level 2 screening:

- Approach and process
- Criteria
- Alternative development
- Issues
- Screening results

3.4.2 Federal Interdisciplinary Team

Four federal interdisciplinary team meetings were held during the Level 2 screening, addressing topics similar to those listed above for the advisory committee meetings.

3.4.3 Public Workshops

On January 16 and 17, 2001, two public workshops were held that concentrated on the evaluation criteria, methodology, and alternatives under consideration during the Level 2 screening. These meetings were held to discuss Level 2 evaluation before it was initiated to ensure that the public and agencies were comfortable with the process and alternatives being studied. Both workshops helped to better define specific evaluation criteria and the alternatives for further study. The January 16 meeting focused on the Transit and Highway Alternative elements. The January 17 meeting focused on interchange analysis, travel forecasts, and environmental screening criteria.

3.4.4 Public Open Houses

Results of the Level 2 screening were presented at open houses held on April 4, 7, and 11, 2001, in three locations along the Corridor.

3.4.5 Newsletters

The March 2001 newsletter provided the rationale for the Level 2 evaluation criteria.

In the June 2001 newsletter, Level 2 evaluation results were disclosed, including those alternative elements eliminated and those advanced for further study.

3.5 Level 3 Screening

The following provides a summary of public and agency coordination during the Level 3 screening process from August 2001 to September 2003.

3.5.1 Mountain Corridor Advisory Committee Meetings

Five meetings were held between August 2001 and April 2003, each addressing aspects of Level 3 screening:

- Alignment studies
- Travel demand model and ridership survey
- Travel demand model results
- Preliminary environmental and community impact findings
- Issues
- Screening results

3.5.2 Federal Interdisciplinary Team

Three federal interdisciplinary team meetings were held during the Level 3 screening addressing similar topics (as listed above for the advisory committee meeting).

3.5.3 Other Stakeholder Meetings

Additional meetings were held with PEIS stakeholders during the Level 3 alternatives refinement and screening process. These meetings included the following entities:

- ALIVE Committee
- Section 4(f) and Section 6(f) Committee
- United States Army Corps of Engineers
- United States Forest Service
- FTA Colorado Urban Maglev Project
- Clear Creek County I-70 Task Force

3.5.4 Newsletters

A May 2003 newsletter provided the rationale for eliminating additional alternatives from further consideration as a result of the Level 3 alignment/technical/environmental studies. In addition, this newsletter described the packaging of alternatives and the description of the 20 Action Alternatives.

A July 2004 newsletter provided the results of CDOT and Federal Highway Administration recommendations for a group of Action Alternatives.

3.5.5 Committees

Subsequent to the development of the Action Alternatives, a number of committees were formed to guide the development of the Preferred Alternative, mitigation strategies and Tier 2 implementation strategies. These committees included:

- **I-70 Mountain Corridor Collaborative Effort Team.** Formed in 2007 to consider the alternatives and reach a Consensus Recommendation about a Preferred Alternative to be fully evaluated in the Revised Draft PEIS. Monthly meetings were held over an 8 month period and the Collaborative Effort Team reviewed the alternatives, confirmed the evaluation criteria, and reviewed comparative analysis information on travel demand modeling and environmental impacts.
- **I-70 Mountain Corridor Context Sensitive Solutions Team.** Formed in 2007 to develop the I-70 Mountain Corridor Context Sensitive Solutions guidance to serve as the framework for all current and future projects along the Corridor.
- **I-70 Mountain Corridor PEIS Project Leadership Team.** Formed in October 2008 with representatives from federal, state, and local agencies.
- **Issues Task Forces.** Formed in 2009 to develop potential mitigation strategies for impacts to resources identified in the 2004 Draft PEIS.

Section 4. Alternative Evaluation and Screening

4.1 Approach

As discussed in **Section 2**, general criteria were developed for each of the three levels of evaluation and screening to address issues and consider alternatives identified during scoping. Initially, general concepts for criteria were developed, followed by more specific criteria for evaluating transportation elements of each family. This section describes the process for each level of screening by family. Level 1 screening applied broad criteria that narrow the range of alternative elements to those that have the opportunity to meet purpose and need. More detailed screening criteria were applied to the remaining alternative elements in Level 2 studies. Alternative elements were refined and screening finalized after consideration of more detailed environmental analyses at Level 3, and packages of Action Alternatives were created for inclusion in the PEIS.

Below is a summary of the evaluation and screening of each family of alternative elements. The element family is briefly described followed by the criteria used for and results of each level of screening. Changes that occurred between the screening levels from additional information, public input or other changes are included if applicable. A summary of the screening including elements forwarded for consideration in the PEIS is also included.

4.2 Transportation Management

4.2.1 Introduction

Transportation Management focuses on reducing Corridor congestion and improving overall mobility on the existing I-70 highway. This family includes an integrated package of Transportation Management strategies that maximize the operational efficiency and person-moving capacity of the Corridor by better balancing the demand for travel on the I-70 highway with the capacity of the I-70 highway to handle travel demand. Many of these strategies rely heavily on public-private partnerships to achieve desired results.

Transportation Management includes the coordinated implementation of transportation demand management (TDM), transportation system management (TSM), and intelligent transportation system (ITS) strategies. As an introduction, the following brief definitions are provided:

- **Transportation Demand Management.** Transportation Demand Management is designed to efficiently use existing transportation facilities by managing the actual "demand" placed on these facilities. Using integrated strategies that maximize available travel-mode choices, increase vehicle occupancy, reduce travel distances, and shift peak-period demand to non-peak periods, TDM programs extend the useful life of transportation facilities and enhance mobility options.
- **Transportation System Management.** Transportation System Management measures involve operational improvements to existing transportation facilities that maximize their person-moving capacity, reduce the severity and duration of temporary (for example, crash and weather) delays, and improve safety.
- **Intelligent Transportation Systems.** Intelligent Transportation Systems involves the application of advanced technologies and communications to optimize the efficiency of transportation systems. Intelligent Transportation Systems applications are often an integrated support element of both TDM and TSM strategies.

Transportation Management strategies generally exclude extensive infrastructure investments aimed at expanding roadway capacity. Instead, these strategies focus on:

- Management of travel demand to reduce the severity and duration of circumstances where travel demand exceeds existing roadway capacity. Modifications to travel demand include adjustments to travel time (by time-of-day and/or day-of-week), travel route, trip distance (through changes in trip origins and destinations), and vehicle occupancy.
- Management of existing Corridor capacity to address locations where relatively minor improvements to the roadway network or highway operations help address temporary or long-term capacity bottlenecks. Temporary bottlenecks include those caused by incidents, weather, and construction factors.

Development and implementation of Transportation Management strategies along the I-70 Mountain Corridor must be tailored to fit the unique recreation based nature of trip-making in the Corridor. Although the national base of experience in Transportation Management is more extensive for urbanized areas, recreation-centered corridors can be particularly appropriate for Transportation Management strategies because they often have highly predictable travel patterns, substantially increased travel demand during specific peak-periods, and relatively concentrated travel destinations. Additionally, corridors with a high volume of recreational trips often have high environmental amenity values tied to both the travel route and the trip destination, increasing the value of transportation strategies with lower environmental impacts.

The coordinated management of both demand and capacity fosters greater efficiency from existing transportation facilities, maximizing their overall person moving and goods-moving capacity. Well-designed, well-coordinated Transportation Management strategies provide win-win solutions to transportation challenges in recreation-centered corridors by improving the overall visitor experience, enhancing economic vitality, and reducing (or delaying) the need for major transportation infrastructure investments with potentially high economic and environmental costs.

The Transportation Management strategies summarized in this section include TDM, TSM, and ITS strategies as part of an integrated package. Transportation Management can be implemented as a standalone alternative or integrated with other action alternatives. The assessment of Transportation Management strategies involved cost, effectiveness in the Corridor, public acceptance, and ability to implement.

4.2.2 Alternative Elements Evaluated

The following 10 Transportation Management Alternative elements were evaluated:

1. **Peak-spreading and vehicle occupancy incentives.** This strategy includes the use of incentives to shift travel demand by time of day and day of week and to increase average vehicle occupancy. Incentives include financial incentives, travel time and convenience incentives, and reward/point program incentives ("frequent flier points"). This strategy encourages travelers to leave congested peak periods and travel at less congested times. Participation by the public is voluntary and includes the promise of improved travel conditions. No capital construction projects are required to implement this alternative element nor does it cause disruption to Corridor travelers.
2. **Enhanced traveler information.** This strategy is designed to allow travelers to make "smart" travel mode and travel time (by time of day and day of week) decisions before departing. It includes programs to notify travelers of incident- and weather-related delays during their travels, provides advanced public transportation schedule and routing information, and provides integrated traveler information before the trip begins. With timely information, travelers can make informed choices about when to travel in the Corridor to reduce peak hour demand. Too often, advanced traveler information programs focus on providing travel information (such as alternate modes, off-peak travel opportunities, and weather/incident delays) to travelers during their trip. However, unless relevant information is received before departure, opportunities for modifications in travel behavior are more limited (particularly due to the limited nature of alternate routes along the I-70 highway). Additionally, traveler information and resort marketing programs should be integrated to maximize opportunities for comprehensive travel planning (integrating choices regarding travel dates, destinations, and duration with choices regarding travel mode and departure time). The "messaging" of resort marketing and travel information should be coordinated and unified. This strategy requires a minor amount of capital construction.
3. **Park-and-rides.** This involves the use of public, private, and joint-venture park-and-ride/intermodal transfer facilities to facilitate high occupancy travel options for trips originating in the Denver metropolitan area.
4. **Parking operations and incentive plans.** Includes programs to manage existing and future parking facilities at major I-70 Mountain Corridor destinations.
5. **Bicycle improvements.** Includes improvements to bicycle connectivity and safety within the I-70 Mountain Corridor communities. This includes investment in bicycle facilities and road-crossings, and improvements in bike-on-transit infrastructure.
6. **Ramp metering.** This strategy regulates the amount of vehicles entering the freeway system by the use of traffic lights at on-ramps. Its objective is to maximize achieved flow on the highway mainline and prevent the onset of congestion. This strategy has to be interactive with the changing demand patterns throughout the day (and week). This strategy must also react to incidents or lane closures and if its presence at a location changes the demand pattern, the metering should track and change accordingly.
7. **Slow-moving vehicle plan.** This strategy aims to increase capacity on the I-70 highway for peak-hour, peak-direction travel by limiting the left lane to vehicles maintaining a specified minimum speed throughout the steep grades present on this Corridor. The slower traffic is restricted to the right lane to achieve the higher capacity. Additional facilities that help improve slow-moving vehicle travel at all times, such as chain-up stations, rest areas, weigh-in-motion, and automated vehicle identification facilities, are part of this strategy. For this study, slow-moving vehicles are defined as:
   - Vehicle or combination of vehicles with a gross weight of 12,001 pounds
   - Vehicles towing a trailer or semitrailer, regardless of size

This definition is similar to the vehicle definition in laws restricting left lane use in the states of Utah and Washington. This vehicle definition allows for straightforward enforcement, although there may be some restricted vehicles with higher performance capabilities than non-restricted vehicles.

These restrictions limit slow-moving vehicles from using the left lane when there are three or more lanes in one direction. Restrictions involving limitations on peak-period usage by slow-moving vehicles during a several-hour period on weekends have been investigated using traffic simulation. Due to the increased capacity provided by the exclusion of these vehicles from the traffic stream, substantial reductions in congestion have been observed. However, there are questions about the legality of time-based restrictions on peak hour travel, which could preclude implementation.

8. **Winter Park Ski Train.** Provides an effective way of traveling to the Winter Park Resort. It runs on tracks owned and operated by the Union Pacific Railroad, and therefore, is subject to their requirements. There is one ski train per day that goes to Winter Park on Fridays, Saturdays, and Sundays. Given the requirements of Union Pacific Railroad, at most, one more trip could be added to each of these days. As of 2009, Ski Train service has been discontinued due to lack of funding.
9. **Buses/shuttles in mixed traffic (mileposts 176–260).** Provides support for rolling stock purchases and implementation of minimum revenue guarantees for private transportation providers providing connections between Denver International Airport, Front Range locations, and various I-70 Mountain Corridor destinations.
10. **Limited-access frontage roads in Clear Creek County.** This strategy limits travel on the frontage roads between Hidden Valley and Bakerville to usage by transit vehicles and Clear Creek County residents during peak travel hours. Electronic card controlled access gates are used to control access. This strategy increases transit usage in the Corridor by decreasing transit vehicle travel times. However, there are questions about the legality of limited access frontage roads, which could preclude implementation.

4.2.3 Level 1 and Level 2 Screening

Evaluation of Transportation Management Alternative elements focused on the project purpose and need, compatibility with current or future characteristics of the Corridor, and safety. All ten Transportation Management Alternative elements were advanced to Level 3 screening because of their ability to provide benefit without major capacity construction to address congestion and mobility needs in the Corridor.

4.2.4 Level 3 Screening

At Level 3 screening, three of the ten Transportation Management Alternative elements were eliminated because they did not respond to the purpose and need of reducing congestion and improving mobility and safety in an efficient manner.

- **Bicycle improvements.** Bicycle improvements alone do not have the ability to remove substantial traffic from the Corridor to reduce congestion. For the vast majority of trips on the I-70 highway, bicycling is not a valid option because of the mountainous terrain, weather conditions throughout much of the year, and length of the Corridor. For overnight trips and some recreational trips (skiing), bicycling does not provide a valid option for enough travelers to reduce congestion on the Corridor. This alternative element was eliminated, but included as part of mitigation strategies.
- **Limited-access frontage roads in Clear Creek County.** Eliminated because frontage roads along the Corridor are considered state and federal highways and access cannot be limited or

restricted to Clear Creek County residents or a particular vehicle type. In addition, at most this alternative element diverts 2 percent of traffic along the Hidden Valley to Bakerville stretch of the I-70 highway, which is not enough traffic to change operations or reduce travel time in the Corridor. Long-haul transit on frontage roads does not provide attractive travel conditions compared to travel on the I-70 highway.

- **Winter Park Ski Train.** Eliminated due to the volume of freight trains through the Moffat Tunnel, which allows for a maximum of two Winter Park Ski Trains to run in each direction. Two trains to Winter Park, a single destination, do not remove enough traffic to change operations or reduce travel time in the Corridor. The seat capacity for one train is 750 seats. An additional train provides a 1,500 total seat capacity. No additional trips would be possible due to freight use on this line. The travel demand in 2035 on a winter Saturday westbound at the Twin Tunnels was estimated at 5,100 vehicle trips at peak hour, which would be at a Level of Service F for 3 hours. The demand would be over capacity by 1,700 vehicles. The Ski Train accounts for a reduction of only 600 vehicles at peak hour. The Winter Park Ski Train was discontinued in 2009 due to lack of funding.

4.2.5 Alternative Elements Advanced for Evaluation in the PEIS

The remaining seven Transportation Management Alternative elements were advanced for evaluation in the PEIS. These alternative elements meet a portion of the purpose and need for the project by providing the best opportunity to improve operational efficiency without major capacity additions. This is especially true when implemented in combination with other transportation improvements.

- **Peak-spreading and vehicle occupancy incentives.** Advanced as a strategy to encourage travelers to avoid the congested peak periods and travel at less congested times. Participation is voluntary, but includes the promise of improved travel conditions by offering incentives (monetary or otherwise) for people who elect to travel or carpool at less congested times of the day. No capital construction projects are required to implement this alternative element nor does it cause disruption to Corridor travelers.
- **Enhanced traveler information.** Advanced as a means to provide timely traffic information allowing travelers to make more informed choices about when to travel to avoid congested periods, reduce peak hour demand, and improve mobility and safety. This strategy requires very little capital construction and does not cause disruption to Corridor travelers.
- **Park-and-rides.** Advanced as a means to encourage carpooling and obtain higher occupancies to reduce congestion and improve mobility in the Corridor. To be most effective, locations should be well located to encourage use. The Hogback park-and-rides are highly successful. This requires some upfront funding to build new or expand existing facilities.
- **Parking operations and incentive plans.** Advanced to increase vehicle occupancies and encourage transit use, reducing the number of single vehicles traveling, thereby improving mobility and reducing congestion. This plan requires coordination between ski resorts, Corridor communities, public recreation areas, and other managed parking lots along the Corridor to manage the long-term parking capacity. Incentives include a combination of direct financial incentives, priority access to destinations, and the Colorado Mountain Plus rewards program.
- **Ramp metering.** Advanced as an effective means to help maintain traffic flow during peak demand and has been used successfully in other areas of the country and in Colorado. Ramp metering requires minimal upfront capital cost and maintenance with no disruption to Corridor travelers.
- **Slow-moving vehicle plan.** Advanced to develop facilities that help improve slow-moving vehicle travel at all times. This plan includes chain-up stations, rest areas, weigh-in-motion, and

automated vehicle identification facilities. Additional studies are necessary to address the questions about the legality of time-based restrictions on peak hour travel as previously noted.

- **Buses/shuttles in mixed traffic (mileposts 176–260).** Advanced as a strategy to introduce more frequent service in the Corridor. Since buses are in mixed traffic, there is little travel time improvement over driving, but it provides an alternate mode to driving.

For more information on each of the seven Transportation Management alternative elements advanced, see **Appendix A**, *Transportation Management Alternatives*.

4.2.6 Summary

The results of the evaluation process for the Transportation Management alternative elements are summarized in **Table 1**.

Table 1. Transportation Management Alternative Elements

Transportation Management Alternative Element	Screened—Level 1 Screening	Screened—Level 2 Screening	Screened—Level 3 Screening	Advanced for Action Alternative Development
Ramp Metering				✓
Slow Moving Vehicle Plan				✓
Peak Spreading and Vehicle Occupancy Incentives				✓
Park-and-Rides				✓
Enhanced Traveler Information				✓
Bicycle Improvements			X[1]	
Limited Access Frontage Roads (Clear Creek County)			X	
Parking Operations and Incentives Plan				✓
Winter Park Ski Train			X	
Buses in Mixed Traffic (milepost 176–260)				✓

[1]*Element can be revisited during Tier 2 for mitigation.*

4.3 Localized Highway Improvement Alternative Elements

4.3.1 Introduction

Localized Highway Improvements focus on reducing Corridor congestion and improving overall mobility on the existing I-70 highway by making improvements to localized spots along the Corridor rather than adding capacity throughout the Corridor. This family of elements includes an integrated package of localized highway improvement strategies that maximize the operational efficiency, safety, and person-moving capacity of the Corridor by correcting structural and functional deficiencies of interchanges, curves, and localized areas of congestion.

Localized Highway Improvement Alternative elements can be implemented as standalone elements or integrated as a complement to other alternatives.

4.3.2 Alternative Elements Evaluated

The following three Localized Highway Improvement Alternative elements were evaluated:

- **Interchange improvements.** This alternative element consists of modifying structurally deficient and functionally obsolete interchanges to improve capacity in merging and weaving sections for more efficient entry onto or exit from the I-70 highway.

  Many interchanges along the I-70 Mountain Corridor do not meet current design and safety standards. Some existing interchanges have substandard acceleration and deceleration lengths for entrance and exiting ramps causing traffic to backup onto the I-70 highway creating a safety hazard for mainline I-70 highway traffic. These types of roadway deficiencies are the cause of interchange capacity reduction and result in traffic delays and congestion on the I-70 highway itself. The interchange improvements alternative element provides adequate roadway features that approach or meet the current FHWA/CDOT design standards.

  This alternative element includes extending the existing ramps to accommodate the increased traffic flow, adding acceleration and deceleration lanes to provide a smooth merge to I-70 highway mainline traffic, adding lanes to interchange on- and off-ramps to accommodate higher traffic demands, and considering interchange access consolidation. This alternative element also incorporates the usage of TDM specific to interchanges, such as ramp metering.
- **Curve safety modifications.** Several locations within the Corridor have curves with substandard geometry that do not have the same design speed as adjacent sections of the I-70 highway. This requires travelers to slow considerably to navigate the curve causing safety and mobility issues. This alternative element replaces tight curves with smooth curves that meet a higher design speed on the I-70 highway. This type of roadway geometric improvement can increase the roadway capacity without adding additional lanes.
- **Auxiliary lanes.** Many locations throughout the Corridor have steep grades of over 6 percent. These locations experience congestion due to slow-moving vehicles. This alternative element provides additional lanes in key locations between interchanges to address localized congestion, due to steep grades and slow-moving vehicles.

4.3.3 Level 1 and Level 2 Screening

Localized Highway Improvement Alternative elements were not eliminated at the Level 1 or Level 2 screening because these elements became part of the Corridor-wide capacity improvement alternatives.

4.3.4 Level 3 Screening

Each Localized Highway Improvement Alternative element was screened separately during the Level 3 analysis. The Localized Highway Improvement Alternative elements were evaluated based on the I-70 Mountain Corridor purpose and need factors (mobility and congestion) and also considered safety.

Mobility and congestion are functions of the volume/capacity (V/C) ratio, representing traffic flow conditions within a segment or at a specific location. Analysis of Corridor interchanges is based on year 2000 volumes on the I-70 highway and the future predicted volumes on the I-70 highway in 2035. These volumes were input into the model that simulates traffic flow characteristics on the interchange ramps or highway to produce a V/C ratio. Volume/capacity ratios are only used for interchange improvements. If the V/C ratio is greater than 1.00, the capacity of the interchange is not adequate to handle the current or projected volume. Therefore, the alternative element was identified as a problematic area and retained for analysis in the PEIS.

Safety is quantified by a weighted hazard index (WHI). A WHI compares the weighted crash rate, measured as weighted crashes (higher weight given to a higher severity crash) per million vehicle miles of travel, at a location in the Corridor compared to the statewide average weighted crash rate for similar roadways. This determines if the observed rate is higher than the statewide average. If a WHI is greater than 0.00, it signifies that the location in question has a higher weighted crash rate than the statewide average and is a potentially problematic area in terms of the number of crashes observed or their severity. Improvements at these locations were retained for analysis in the PEIS. The most current WHI data available is for the years 2001 – 2005. Analysis was initially conducted using the 1996 – 2001 WHI, but has been updated with the 2001 – 2005 WHI data. There are differences in the rates and if an area was identified as having a safety issue under either sets of data it was retained for analysis in the PEIS. While minor effects may occur to the environmental resources at these locations, they would not change the comparative analysis or the recommendation at the tier 1 level. New crash data will be used in Tier 2 processes.

Interchange Improvements

Assessment of the need for improvement focused on mobility and capacity (as measured by the V/C ratio) and safety problems (as measured by WHI) if ramp queues were backing up on to the I-70 highway and local public support. Corridor stakeholders provided input on the various locations for improvements, and their input was considered as part of the rating process when an interchange did not meet the criteria for an A rating as listed below. See **Table 2** and the *I-70 Mountain Corridor PEIS Safety Technical Report (CDOT, August 2010)* for details on the interchange improvements.

All interchanges are analyzed for improvements and given a priority rating of A, B, or C based on the criteria below.

- A priority rating of “A” is given if the interchange experiences severe congestion causing queues to back up onto mainline I-70 highway from the ramps or if an interchange meets **both** of the following criteria:
  - V/C ratio greater than or equal to 1.00 and
  - WHI greater than or equal to 0.00
- A priority rating of “B” is given if the interchange meets **either** of the following criteria:
  - V/C ratio greater than or equal to 1.00 or
  - WHI greater than or equal to 0.00 and public interest.
- A priority rating of “C” is given if the interchange meets **both** of the following criteria:
  - V/C ratio less than 1.00 and
  - WHI less than 0.00.

Of the 40 interchanges evaluated for the Corridor, 15 were initially eliminated during the Level 3 screening. Since obtaining updated WHI data and 2035 V/C ratios, the Wolcott interchange (milepost 156) is retained for more detailed evaluation in Tier 2. Based the criteria, the following 14 interchanges do not require any improvements and are eliminated from further consideration:

- Dotsero (milepost 133)
- Vail (milepost 176)
- Vail East Entrance (milepost 180)
- Vail Pass (Shrine Pass Road) (milepost 190)
- Officers Gulch (milepost 198)
- Herman Gulch (milepost 218)
- Bakerville (milepost 221)
- Lawson (milepost 233)
- Dumont (milepost 235)
- Hidden Valley (milepost 243)
- El Rancho (milepost 251)
- Evergreen/State Highway (SH) 72 (milepost 252)
- Chief Hosa (milepost 253)
- Genesee (milepost 254)

Table 2. Analysis of I-70 Interchanges

Name	WHI 2001 to 2005	2035 Critical V/C Ratio	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Glenwood Springs (milepost 116)	1.09	2.54	A	Problem: Inadequate westbound on-ramp and eastbound off-ramp geometry. Off-ramp traffic currently backs onto the I-70 highway. **Improvement:** Interchange improvements constitute the westernmost local safety and capacity improvement. Improvements include upgrades to all existing ramps, including widening and lengthening, and signalization of the interchanges on SH 82 at the bottom of the I-70 highway ramps.
Dotsero (milepost 133)	-1.73	0.31	C	Based on criteria, improvements are not warranted.
Gypsum (milepost 140)	-0.62	2.23	A	**Problem:** Extensive development in western Eagle County is expected to result in excess travel demand at this unsignalized interchange. Future traffic is expected to backup onto the I-70 highway. **Improvement:** Upgrade stop signs to signals, which will improve capacity, mobility and safety.
Eagle & Spur Road (milepost 147)	-0.29	3.00	A	**Problem:** This interchange is expected to see traffic demand increasing with local development. There is inadequate ramp termini signal configuration. The spur road is currently overcapacity during peak hours. Future traffic is expected to back onto the I-70 highway. **Improvement:** Improvements reconstruct the interchange and increase the capacity of the spur road that connects the I-70 highway and US 6.
Wolcott* (milepost 157)	-0.80	1.35	B	**Problem:** The unsignalized intersections are inadequate for future demand. **Improvement:** This element adds traffic signals to improve capacity. Improvements will be examined in Tier 2.
Edwards & Spur Road (milepost 163)	0.62	1.94	A	**Problem:** Continued development in Edwards results in increased congestion at this interchange. There is inadequate ramp terminal signal configuration. The spur road is currently overcapacity during peak hours. Future traffic is expected to back onto the I-70 highway. **Improvement:** Improvements reconstruct the interchange and increase the capacity of the spur road that connects the I-70 highway and US 6.
Avon (milepost 167)	1.53	1.40	A	**Problem:** The westbound off-ramp at Avon is anticipated to have traffic backing onto the I-70 highway in the future. **Improvement:** The Avon interchange is modified with improved acceleration and deceleration lanes to create more capacity.

Table 2. Analysis of I-70 Interchanges

Name	WHI 2001 to 2005	2035 Critical V/C Ratio	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Minturn (milepost 171)	-0.09	2.51	B	**Problem:** The Minturn interchange is a partial-cloverleaf on a mainline curve. Tight ramp loops and the curves in the mainline contribute to crashes. The eastbound off-ramp also has safety issues resulting from a single approach lane for both the through traffic to Minturn and the traffic turning right to go to Vail. **Improvement:** A separate right turn lane for the eastbound on-ramp traffic is provided, along with other minor reconstruction elements such as improving roadside lighting to improve safety and capacity. The I-70 highway mainline curves are a separate issue that is addressed under curve safety.
Vail West/Simba Run (milepost 173)	1.63	1.40	A	**Problem:** The roundabouts at the Vail West Entrance carry heavy volumes of both local and regional traffic. The eastbound acceleration lane is too short and there is inadequate capacity to handle the high eastbound off-ramp volume. As a result, traffic currently backs onto the eastbound I-70 highway. **Improvement:** The improvement involves construction of the "Simba Run" underpass, which connects the north and south frontage roads between the Vail West Entrance and Vail Main Entrance (milepost 176). This element relieves local traffic pressures on the interchange roundabouts and lengthens an inadequate eastbound on-ramp acceleration lane.
Vail (milepost 176)	0.59	0.87	C	Based on criteria, improvements are not warranted.
Vail East (milepost 180)	0.79	0.92	C	Based on criteria, improvements are not warranted.
Shrine Pass Rd. (milepost 190)	0.37	0.22	C	Based on criteria, improvements are not warranted.
Copper Mountain (milepost 195)	1.89	0.66	B	**Problem:** Crashes primarily occur during adverse weather conditions, especially on the eastbound on-ramp. Crashes are related to topography of roadway. **Improvement:** This improvement modifies the interchange—also known as Wheeler Junction—to provide greater safety.
Officers Gulch (milepost 198)	-0.25	0.04	C	Based on criteria, improvements are not warranted.
Frisco/Main Street (milepost 201)	0.21	1.38	A	**Problem:** The unsignalized intersections are inadequate for future demand. Off-ramp traffic currently backs onto the I-70 highway. **Improvement:** This element replaces the current stop signs with traffic signals to improve capacity.

Table 2. Analysis of I-70 Interchanges

Name	WHI 2001 to 2005	2035 Critical V/C Ratio	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Frisco/SH 9 (milepost 203)	-0.23	1.63	B	**Problem:** The single-lane eastbound on-ramp has inadequate capacity. Ramp storage is inadequate for westbound off-ramp. The acceleration lane for the eastbound on-ramp is too short and is uphill. The primary issue is severe congestion on SH 9. **Improvement:** This improvement provides a two-lane eastbound on-ramp and acceleration lane approximately to the scenic overlook (milepost 202.5 to 203). The acceleration and deceleration lanes are lengthened. This allows southbound traffic on SH 9 to use both lanes throughout the town of Frisco, which helps to reduce or eliminate queuing at the multiple traffic signals. This increases the westbound off-ramp ramp storage.
Silverthorne (milepost 205)	1.93	2.39	A	**Problem:** High traffic volumes in the eastbound and westbound directions, along with several signalized intersections within a short distance, suggests the need for redesign of interchange and adjoining intersections. Future off-ramp traffic is expected to back onto the I-70 highway and considerable congestion on US 6 and SH 9 is also expected. **Improvement:** Rebuilding the interchange, likely as a single-point urban interchange, mitigates congestion and safety issues.
Loveland Pass (milepost 216)	4.53	0.66	B	**Problem:** Safety and capacity problems because of short merges in the eastbound and westbound directions. **Improvement:** This improvement provides longer acceleration and deceleration lanes at the Loveland Pass interchange. This results in greater capacity and safer merging.
Herman Gulch (milepost 218)	-0.87	0.03	C	Based on criteria, improvements are not warranted.
Bakerville (milepost 221)	-0.93	0.16	C	Based on criteria, improvements are not warranted.
Silver Plume (milepost 226)	0.91	0.21	B	**Problem:** There is public interest in moving the western ramps because the ramps are short (capacity problem) and very close to existing development. **Improvement:** The western ramps are moved to the location about 1 mile to the west where the I-70 highway goes over the frontage road. At this new location, greater ramp capacity is provided.
Georgetown (milepost 228)	0.79	2.05	A	**Problem:** Unsignalized intersections are inadequate for future demand. Future traffic is expected to back onto the I-70 highway. **Improvement:** Proposed improvements are to signalize the ramps, provide turn bays, and build a roundabout at Argentine Street, which improve capacity.

Table 2. Analysis of I-70 Interchanges

Name	WHI 2001 to 2005	2035 Critical V/C Ratio	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Empire (milepost 232)	0.78	1.10	A	**Problem:** High eastbound traffic volumes, curve in road, and insufficient acceleration and deceleration lanes for the on- and off-ramps cause crashes in the ramp influence area–primarily a safety issue. **Improvement:** To improve safety, longer eastbound acceleration and deceleration lanes are provided.
Lawson (milepost 233)	-0.86	0.63	C	Based on criteria, improvements are not warranted.
Downieville (milepost 234)	0.44	1.94	A	**Problem:** The north side of the Downieville interchange has two unsignalized intersections within about 50 feet of each other, where the crossroad meets up with the westbound ramps and then the frontage road. Currently, the intersections have limited capacity and often cause long queues on the frontage road. Future traffic is expected to back onto the I-70 highway. **Improvement:** Providing traffic signals at ramps and the four-way stop at the frontage road as well as providing turn bays improves capacity.
Dumont (milepost 235)	-0.13	0.50	C	Based on criteria, improvements are not warranted.
Fall River Road (milepost 238)	-0.86	1.64	B	**Problem:** Eastbound off-ramp and westbound acceleration lane are inadequate. Fall River Road is not connected to the frontage road, creating additional traffic. **Improvement:** Minor ramp modifications are made. Additionally, a spur road is constructed over Clear Creek to connect the interchange with the frontage road. The spur road provides a direct connection to the frontage road, removes local traffic from the I-70 highway and improves local access. Improvements at the Fall River Road interchange address capacity issues.
Idaho Springs West (milepost 239)	-0.34	>2.00	B	**Problem:** At the intersection of the ramps and the frontage road, there are high levels of congestion, which affects the I-70 highway. **Improvement:** The intersection of the off-ramp and the frontage road and ramp geometry are modified, improving traffic flow.
Idaho Springs/ SH 103 (milepost 240)	-0.67	1.58	B	**Problem:** There are no turn bays between ramp terminals and the ramps are narrow. There is also active pedestrian use. **Improvement:** Ramps are modified to improve pedestrian safety and left-turn bays are provided on the crossroad. Traffic flow is improved at ramp intersections.

Table 2. Analysis of I-70 Interchanges

Name	WHI 2001 to 2005	2035 Critical V/C Ratio	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Idaho Springs East (milepost 241)	-0.86	1.93	A	**Problem:** The eastbound off-ramp becomes congested due to high through traffic on to the eastbound on-ramp. Acceleration and deceleration lanes are inadequate. There are very sharp curves for ramps with design speeds of 10 to 20 miles per hour. Currently, the heavy eastbound on-ramp volume blocks traffic using the eastbound off-ramp during peak hours. Future traffic is expected to back onto the I-70 highway. **Improvement:** This interchange is rebuilt with sufficiently long acceleration and deceleration lanes. The two loop off-ramps with 15 miles per hour advisory speeds are replaced, allowing safer and more efficient movement of local traffic.
Hidden Valley (milepost 243)	-1.56	0.56	C	Based on criteria, improvements are not warranted.
Base of Floyd Hill/ US 6 (milepost 244)	2.74	0.56	B	**Problem:** The westbound on-ramp is at the base of a steep hill, on a sharp curve, has a sight distance problem, and feeds a high traffic volume onto a highway that is often near capacity during peak hours before the merge. This is a critical safety issue in an area with very high demand. **Improvement:** This interchange is rebuilt with right-handed exit and entrance ramps to improve safety. Reconstruction of the interchange may result in a safer, higher design speed curve on the I-70 highway. Capacity of the sub-standard westbound on-ramp is improved, lessening congested conditions that currently occur.
Hyland Hills (milepost 247)	-0.02	2.39	A	**Problem:** High volume traffic going from westbound off-ramp to frontage road can cause traffic to back onto the I-70 highway. Eastbound off-ramp has glare issues. Future traffic is expected to back onto the I-70 highway. **Improvement:** The Hyland Hills interchange includes modified ramps to increase capacity and address glare issues.
Beaver Brook (milepost 248)	-0.02	2.39	A	**Problem:** High volume traffic going from westbound off-ramp to frontage road can cause traffic to back onto the I-70 highway. Eastbound off-ramp has glare issues. Future traffic expected to back onto the I-70 highway. **Improvement:** The Beaver Brook interchange includes modified ramps to increase capacity and address glare issues.
El Rancho (milepost 251)	-0.47	0.29	C	Based on criteria, improvement is not warranted.
Evergreen/SH 74 (milepost 252)	-0.57	1.06	C	This interchange did not warrant an improvement during initial screening. More recent data shows a V/C ratio minimally over 1.00; therefore the C rating is retained. This interchange will be reexamined during Tier 2 with updated data.
Chief Hosa (milepost 253)	-0.83	0.77	C	Based on criteria, improvements are not warranted.

Table 2. Analysis of I-70 Interchanges

Name	WHI 2001 to 2005	2035 Critical V/C Ratio	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Genesee (milepost 254)	-0.27	0.75	C	Based on criteria, improvements are not warranted.
Lookout Mountain (milepost 256)	1.04	1.64	A	**Problem:** Unsignalized intersections are inadequate for future demand. There are no turn bays between the ramp terminals. Future traffic is expected to back onto the I-70 highway. **Improvement:** The interchange is rebuilt to address future increases in demand.
Morrison (milepost 259)	-0.06	1.27	B	**Problem:** Future demand at this interchange with the Hogback park-and-ride will cause traffic to back onto the I-70 highway. **Improvement:** Improvements to help operations associated with the expanded Hogback park-and-ride facility at this interchange were recently completed. These improvements included an additional left turn lane for eastbound on-ramp traffic and a westbound acceleration lane with improvements at each on- and off-ramp as they intersect US 40.

** Wolcott interchange was initially eliminated from consideration for improvements but based on updated WHI and V/C data, the interchange will require improvement by 2035 and is included in the list advanced for localized highway improvements.*

Curve Safety Modifications

The need for the curve safety modifications in the Corridor is based on safety – as determined by WHI, and curve design – as determined by the design speed of the curve. A WHI threshold of 2.00 was selected because curves are generally more prone to crashes and high WHI values are not uncommon. Substandard design corresponds to locations where the highway design speed on the curves is less than the posted speed limit as well as adjacent portions of the highway. V/C ratio information is not applicable to the curve safety analysis.

Curves are given a priority rating of A, B, or C depending on the following criteria.

- An “A” rating is given if the curve meets **both** of the following criteria:
  - WHI greater than 2.00 and
  - Design speed less than 65 miles per hour (mph)
- A “B” rating is given if the curve meets **either** of the following criteria
  - WHI greater than 2.00 or
  - Design speed less than 65mph
- A “C” rating is given if the curve meets **neither** of the following criteria:
  - WHI greater than 2.00 nor
  - Design speed less than 65mph

Of the five curves identified for potential safety modifications, one was eliminated during Level 3 screening. Based on the criteria, the “East of Wolcott Interchange” curve did not warrant any improvements and was eliminated from further consideration. See **Table 3** and the *I-70 Mountain Corridor PEIS Safety Technical Report* (CDOT, August 2010) for details on each of the curve safety modifications.

Table 3. Analysis of I-70 Curve Safety

Name	WHI 2001 to 2005	Design Speed (mph)	2035 Priority Rating	Descriptions of Problem Areas and Proposed Improvements
East of Wolcott Interchange (mileposts 158–159)	1.38	65	C	Based on criteria, improvements are not warranted.
West of Wolcott Interchange (mileposts 155–156)	2.01	55	A	**Problem:** The design speed of the curve is less than that for surrounding portions of the highway. There is a critical safety issues in an area with relatively less demand. **Improvement:** Curve safety modifications improve safety.
Dowd Canyon (mileposts 170–173)	1.89	50	B	**Problem:** The design speed of the curve is less than that for surrounding portions of the highway. There is a critical safety issues in an area with very high demand. **Improvement:** Curve safety modifications improve safety.
Fall River Road (mileposts 237–238)	1.43	55	B	**Problem:** The design speed of the curve is less than that for surrounding portions of highway. There is a high amount of incident-related delay; but not a major capacity issue. **Improvement:** Curve safety modifications improve safety.
East of Twin Tunnels to US 6 (mileposts 242–245)	1.16	45	B	**Problem:** The design speed of the curve is less than that for surrounding portions of the highway. There is a critical safety issues in an area with very high demand. **Improvement:** Curve safety modifications improve safety.

Auxiliary Lanes

The need for auxiliary lanes was assessed on the basis of capacity, mobility, and safety. Capacity and mobility issues were determined based on substandard design. Substandard design issues include tight interchange spacing (less than 2 miles), steep grades, and inadequate acceleration or deceleration lanes. Safety issues were identified for locations with high WHI values. A threshold of 2.5 was selected because merge and diverge areas are generally more prone to crashes and high WHI values are not uncommon.

Auxiliary lanes were analyzed and given a priority rating of A, B, or C based on the criteria below:

- A priority rating of “A” is given if an auxiliary lane location meets **both** of the following criteria:
  - WHI greater than 2.50 and
  - Substandard geometry
- A priority rating of “B” is given if an auxiliary lane location meets **either** of the following criteria:
  - WHI greater than 2.50 or
  - Substandard geometry
- A priority rating of “C” is given if an auxiliary lane location meets **neither** of the following criteria:
  - WHI greater than 2.50 nor
  - Substandard geometry

Volume-to-capacity ratios are not applicable to the auxiliary lane analysis. Weighted hazard index values and design issues are presented with the assigned priority rating and potential improvements for auxiliary lanes in **Table 4**.

Of the 14 potential locations identified for auxiliary lanes, two were eliminated during Level 3 screening. Based on the criteria, the "Chief Hosa to Genesee, Flat" potential auxiliary lane location and the "US 6 to Hyland Hills" potential auxiliary lane location did not warrant any improvements and were eliminated from further consideration.

Table 4. Analysis of I-70 Auxiliary Lanes

Name	WHI 2001 to 2005	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Avon to Post Boulevard, Uphill (Eastbound) (mileposts 167–168)	-0.45	B	**Problem:** The I-70 highway between Avon (milepost 167) and Post Boulevard (milepost 168) is uphill. Traffic merging from the Avon on-ramp has difficulty accelerating on the grade and finding sufficient gaps for merging. Traffic attempting to get from the I-70 highway to the Post Boulevard off-ramp creates a problematic weaving issue. The interchanges are only 1 mile apart. **Improvement:** An auxiliary lane between these two interchanges increases safety and improves merge capacity. It also allows local traffic to stay in the auxiliary lane and not affect the I-70 highway mainline.
West Side of Vail Pass, Uphill (Eastbound) (mileposts 180–190)	4.78	A	**Problem:** Steep 7 percent grades limit the highway capacity. Demand is expected to exceed capacity occasionally in the future. **Improvement:** A new eastbound auxiliary lane provides additional capacity by allowing more space for fast-moving vehicles to pass slow-moving vehicles struggling with the steep grades.
West Side of Vail Pass, Downhill (Westbound) (mileposts180–190)	1.34	B	**Problem:** There is a high amount of incident-related delay possible because of adverse weather conditions, steep grades and curves; not a major capacity issue. **Improvement:** Curve smoothing, more intensive winter maintenance practices with ice sensors and better signage helps to reduce the number of crashes. A westbound auxiliary lane is primarily a safety improvement, reducing the likelihood of rear-end collisions with slow-moving vehicles and providing an increase in roadway capacity. Reducing the frequency of crashes also reduces the delay associated with clearing the disabled vehicles.
Frisco to Silverthorne (Eastbound) (mileposts 202.7–205.1)	0.23[1]	B	**Problem:** Travel demand west of Silverthorne from local trips combined with through traffic results in Level of Service F for eastbound travel between Frisco and Silverthorne. **Improvement:** An eastbound auxiliary lane is added between Frisco and Silverthorne starting east of the recent eastbound on-ramp extension at the Silverthorne/SH 9 interchange. The addition of an eastbound auxiliary lane improves traffic operations and substantially reduces the number of hours of Level of Service F in the Frisco/Silverthorne area due to congestion

Table 4. Analysis of I-70 Auxiliary Lanes

Name	WHI 2001 to 2005	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Eisenhower-Johnson Memorial Tunnels to Herman Gulch, Downhill (Eastbound) (mileposts 215–218)	2.56	A	**Problem:** The eastbound lanes from the Eisenhower-Johnson Memorial Tunnels' east portal to Herman Gulch currently experience an above-average crash rate attributed to narrow shoulders, steep grades, and an unexpected left-lane drop before the Loveland Pass on-ramp merge. There is an unusual existing lane configuration, with two lanes expanding to three at the Eisenhower-Johnson Memorial Tunnels and then merging back to two lanes shortly before eastbound on-ramps merge. There is a highly substandard 2-foot shoulder between the Loveland Pass off- and on-ramps. The lack of shoulders and an atypical left lane merge are not expected by drivers. **Improvement:** This improvement provides three standard, continuous eastbound lanes to address the safety and congestion issues in this portion of the I-70 highway. Shoulders are improved to standard width throughout the section.
Bakerville to Eisenhower-Johnson Memorial Tunnels, Uphill (Westbound) (mileposts 215–221)	1.10	A	**Problem:** There is a high concentration of rear-end crashes around the Loveland Pass westbound on-ramp and around the Bakerville interchange. Steep grades westbound from the Bakerville interchange (milepost 221) to the east portal of the Eisenhower-Johnson Memorial Tunnels (milepost 215) cause large disparities in speed between vehicles in different weight classes. These differences in speed reduce capacity and make rear-end crashes more likely. **Improvement:** The addition of a climbing lane reduces the crashes, especially rear-end and sideswipe crashes. The additional lane also improves capacity in this area.
Georgetown to Silver Plume, Uphill (Westbound) (mileposts 226–228)	0.23	B	**Problem:** Steep 6 percent grades limit the highway capacity. Traffic demand is limited by two lanes east of Empire Junction. **Improvement:** A new westbound auxiliary lane provides additional capacity by allowing more space for fast-moving vehicles to pass slow-moving vehicles struggling with the steep grades.
Silver Plume to Georgetown, Downhill (Eastbound) (mileposts 226–228)	0.68	B	**Problem:** There is a high number of rear-end, sideswipe, and fixed-object crashes and a high amount of incident-related delay possible because of steep grades and curves. There are no major capacity issues. **Improvement:** An eastbound auxiliary lane is a safety improvement, reducing the likelihood of rear-end, sideswipe, and fixed-object crashes and also providing an increase in roadway capacity. Reducing the frequency of crashes also reduces the delay associated with clearing disabled vehicles.
Downieville to Empire, Uphill (Westbound) (mileposts 232–234)	-0.89	A	**Problem:** Westbound on-ramp traffic at Downieville, including vehicles stopping at the weigh station, enters the I-70 highway on a steep upgrade. There are also weaving concerns with traffic exiting at Empire Junction. **Improvement:** A westbound auxiliary lane mitigates safety and capacity issues caused by steep grades and minimizes the impact of the weigh station. The lane carries through to Empire Junction where the I-70 highway mainline traffic demand decreases substantially.

Table 4. Analysis of I-70 Auxiliary Lanes

Name	WHI 2001 to 2005	Priority Rating	Descriptions of Problem Areas and Proposed Improvements
Empire to Downieville, Downhill (Eastbound) (mileposts 232–234)	0.64	B	**Problem:** Rear-end crashes occur due to vehicles slowing, stopping in traffic, or changing lanes. There is a high amount of incident-related delay possible. There are no major capacity issues. **Improvement:** An eastbound auxiliary lane is a safety improvement reducing the likelihood of rear-end crashes and providing an increase in roadway capacity. Reducing the frequency of crashes also reduces the delay associated with clearing disabled vehicles.
US 6 Off-ramp to Hidden Valley Off-ramp, Uphill (Westbound) (mileposts 243–244)	0.03	B	**Problem:** Through traffic and traffic heading to the Central City Parkway combine to substantially exceed the capacity of this section. **Improvement:** An additional auxiliary lane is added to provide increased capacity for traffic.
US 6 to Hyland Hills, Uphill (Eastbound) (mileposts 244–247)	-0.81	C	**Problem:** There is an uphill capacity issue. **Improvement:** Based on criteria, improvement is not warranted.
Chief Hosa to Genesee, Flat (Eastbound) (mileposts 252–253)	-0.89	C	Based on criteria, improvement is not warranted. While an auxiliary lane allows local traffic to stay in a separate lane from Evergreen to Genesee, there is insufficient demand to warrant improvement.
Morrison to Chief Hosa, Uphill (Westbound) (mileposts 253–259)	3.01	A	**Problem:** Steep 7 percent grades limit the highway capacity. Increased demand in the future will turn this section into a substantial bottleneck. **Improvement:** An additional westbound auxiliary lane provides additional capacity up this steep section with the highest traffic volumes in the Corridor.

[1]Frisco to Silverthorne was identified during the Collaborative Effort process as a problematic area warranting an auxiliary lane.

4.3.5 Alternative Elements Advanced for Evaluation in the PEIS

Localized Highway Improvement Alternative elements advanced for consideration in the PEIS include interchange improvements, curve safety modifications, and auxiliary lanes.

- **Interchange improvements.** A majority of the interchanges in the I-70 Mountain Corridor are structurally deficient and/or functionally obsolete, or will be by 2035. Of the 40 interchanges evaluated for the Corridor, 26 were advanced for improvement. Assessment of the need for improvement focused on capacity (current or future traffic performance/congestion), mobility, safety problems, and local public support. See **Table 2** for details on the interchange improvement locations. The interchange improvement locations advanced include:
    - Glenwood Springs (milepost 116)
    - Gypsum (milepost 140)
    - Eagle & Spur Road (milepost 147)
    - Wolcott (milepost 157)
    - Edwards & Spur Road (milepost 163)
    - Avon (milepost 167)
    - Georgetown (milepost 228)
    - Empire (milepost 232)
    - Downieville (milepost 234)
    - Silver Plume (milepost 226)
    - Fall River Road (milepost 238)
    - Idaho Springs West (milepost 239)

- Minturn (milepost 171)
- Vail West/Simba Run (milepost 173)
- Copper Mountain (milepost 195)
- Frisco/Main Street (milepost 201)
- Frisco/SH 9 (milepost 203)
- Silverthorne (milepost 205)
- Loveland Pass (milepost 216)
- Idaho Springs/SH 103 (milepost 240)
- Idaho Springs East (milepost 241)
- Base of Floyd Hill/US 6 (milepost 244)
- Hyland Hills (milepost 247)
- Beaver Brook (milepost 248)
- Lookout Mountain (milepost 256)
- Morrison (milepost 259)

- **Curve safety modifications.** Of the five locations of concern for curve safety, four were advanced for full analysis in the PEIS. The need was based on mobility where the speed on the curves was less than the surrounding portions of the highway, and safety issues. See **Table 3** for details on each of the curve safety locations. The four curve safety modification locations advanced include:
  - West of Wolcott Interchange (mileposts 155–156)
  - Dowd Canyon (mileposts 170–173)
  - Fall River Road (mileposts 237–238)
  - East of Twin Tunnels to US 6 (mileposts 242–245)

- **Auxiliary lanes.** Of the 14 potential auxiliary lane locations, 12 were advanced for analysis in the PEIS. The need was assessed on the basis of capacity, mobility, and safety. Auxiliary lanes for slow-moving vehicles, primarily located in areas of steep grades, increase the capacity of a highway for relatively short lengths. See **Table 4** for details on each of the auxiliary lane locations. The auxiliary lane locations advanced include:

  Eastbound auxiliary lanes are located:

  - Avon to Post Boulevard, Uphill (mileposts 167–168)
  - West Side of Vail Pass, Uphill (mileposts 180–190)
  - Frisco to Silverthorne (mileposts 202.7–205.1)
  - Eisenhower-Johnson Memorial Tunnels to Herman Gulch, Downhill (mileposts 215–218)
  - Silver Plume to Georgetown, Downhill (mileposts 226–228)
  - Empire to Downieville, Downhill (mileposts 232–234)

  Westbound auxiliary lanes are located:

  - West Side of Vail Pass, Downhill (mileposts 180–190)
  - Bakerville to Eisenhower-Johnson Memorial Tunnels, Uphill (mileposts 215–221)
  - Georgetown to Silver Plume, Uphill (mileposts 226–228)
  - Downieville to Empire, Uphill (mileposts 232–234)
  - US 6 Off-ramp to Hidden Valley Off-ramp, Uphill (mileposts 243–244)
  - Morrison to Chief Hosa, Uphill (mileposts 253–259)

4.3.6 Summary

The results of the evaluation process for the Localized Highway Improvement alternative elements are summarized in **Table 5**.

Table 5. Localized Highway Improvement Options

Localized Highway Improvement Alternative Elements	Screened—Level 1 Screening	Screened—Level 2 Screening	Screened—Level 3 Screening	Advanced for Action Alternative Development
Interchange Improvements				
Glenwood Springs (milepost 116)				✓
Dotsero (milepost 133)			X	
Gypsum (milepost 140)				✓
Eagle and Spur Road (milepost 147)				✓
Wolcott (milepost 156)				✓
Edwards and Spur Road (milepost 163)				✓
Avon (milepost 167)				✓
Minturn (milepost 171)				✓
Vail West/Simba Run (milepost 173)				✓
Vail (milepost 176)			X	
Vail East (milepost 180)			X	
Vail Pass (Shrine Pass Road) (milepost 190)			X	
Copper Mountain (milepost 195)				✓
Officers Gulch (milepost 198)			X	
Frisco/Main Street (milepost 201)				✓
Frisco/SH 9 (milepost 203)				✓
Silverthorne (milepost 205)				✓
Loveland Pass (milepost 216)				✓
Herman Gulch (milepost 218)			X	
Bakerville (milepost 221)			X	
Silver Plume (Potentially Move West Ramps to milepost 224) (milepost 226)				✓
Georgetown (milepost 228)				✓
Empire (milepost 232)				✓
Lawson (milepost 233)			X	
Downieville (milepost 234)				✓
Dumont (milepost 235)			X	
Fall River Road (milepost 238)				✓
Idaho Springs West (milepost 239)				✓
Idaho Springs/SH 103 (milepost 240)				✓
Idaho Springs East (milepost 241)				✓
Hidden Valley (milepost 243)			X	

Table 5. Localized Highway Improvement Options

Localized Highway Improvement Alternative Elements	Screened—Level 1 Screening	Screened—Level 2 Screening	Screened—Level 3 Screening	Advanced for Action Alternative Development
Base of Floyd Hill/US 6 (milepost 244)				✓
Hyland Hills (milepost 247)				✓
Beaver Brook (milepost 248)				✓
El Rancho (milepost 251)			X	
Evergreen Parkway/SH 74 (milepost 252)			X	
Chief Hosa (milepost 253)			X	
Genesee (milepost 254)			X	
Lookout Mountain (milepost 256)				✓
Morrison (milepost 259)				✓
Curve Safety Modifications				
East of Wolcott Interchange (milepost 158–159)			X	
West of Wolcott (milepost 155–156)				✓
Dowd Canyon (milepost 170–173)				✓
Fall River Road (milepost 237–238)				✓
East of Twin Tunnels (milepost 242–245)				✓
Auxiliary Lanes				
Avon to Post Boulevard, Uphill (eastbound) (milepost 167–168)				✓
West Side of Vail Pass, Downhill (westbound) (milepost 180–190)				✓
West Side of Vail Pass, Uphill (eastbound) (milepost 180–190)				✓
Frisco to Silverthorne (eastbound) (milepost 202.7–205.1)				✓
Eisenhower-Johnson Memorial Tunnels to Herman Gulch, Downhill (eastbound) (milepost 215–218)				✓
Bakerville to Eisenhower-Johnson Memorial Tunnels, Uphill (westbound) (milepost 215–221)				✓
Georgetown to Silver Plume, Uphill (westbound) (milepost 226–228)				✓
Silver Plume to Georgetown, Downhill (eastbound) (milepost 226–228)				✓
Downieville to Empire, Uphill (westbound) (milepost 232–234)				✓
Empire to Downieville, Downhill (eastbound) (milepost 232–234)				✓

Table 5. Localized Highway Improvement Options

Localized Highway Improvement Alternative Elements	Screened—Level 1 Screening	Screened—Level 2 Screening	Screened—Level 3 Screening	Advanced for Action Alternative Development
US 6 Off-ramp to Hidden Valley Off-ramp, Uphill (westbound) (milepost 243–244)				✓
US 6 to Hyland Hills, Uphill (eastbound) (milepost 244–247)			X	
Chief Hosa to Genesee, Flat (eastbound) (milepost 252–253)			X	
Morrison to Chief Hosa, Uphill (westbound) (milepost 253–259)				✓

4.4 Fixed-Guideway Transit

4.4.1 Introduction

Substantial interest in rail transit in the Corridor led to the development and consideration of many transit options. While prescreening eliminated short haul or specialty systems that are clearly inappropriate in the Corridor (such as escalators, moving sidewalks, funiculars, aerial tramways, and gondolas) many other Fixed-Guideway Transit Alternative elements were evaluated. The Fixed-Guideway Transit family includes Alternative elements related to four major transit modes:

- **Automated Guideway Transit** systems provide service without a human operator. Therefore, the guideway must be completely protected to ensure that the automated vehicles cannot contact people, automobiles, or other obstacles in the guideway. For this reason they generally operate only short distances and stay within the definition of an "urban" system. They can be operated using conventional rail transit steel wheel vehicles, rubber tires with a guide mechanism, or on a monorail. They are usually differentiated five ways: where they operate, whether they can operate outside, whether they operate with more than one independent vehicle per guideway, whether they can operate multiple routes, and the propulsion mode of the vehicle. Few large-scale Automated Guideway Transit systems exist.
- **Rail Transit** consists of both light rail transit and heavy rail transit. Each transit system can be constructed as a double-track line or a single-track line with passing sidings. The tracks could be located in the I-70 highway median or on a parallel alignment. Both systems could be diesel or electric propelled. The light rail transit and heavy rail transit designs considered for this Corridor would consist of conventional rail vehicles designed to operate on tracks not connected to the national railroad network and not regulated by the Federal Railroad Administration (FRA). Light rail transit is designed for medium capacity urban and suburban transportation. It can operate in mixed street traffic because its vehicles are smaller, more flexible, and can meet highway operating standards. Light Rail Transit typically operates in an exclusive right-of-way. Heavy rail transit is designed for high capacity urban and suburban transportation. It requires an exclusive right-of-way due to its large vehicle size, long train lengths, inability to brake and accelerate with motor vehicle tolerances, and (often) the presence of a ground mounted electric third (power) rail.
- **Passenger Railroads** are conventional rail vehicles operating on track connected to the national railroad network. These systems, which can be diesel or electric propelled, are regulated by the FRA and as such must comply with various construction standards and operating regulations promulgated by the FRA. Passenger Rail trains operate throughout the United States. When

operated between a major city and its suburbs, the service is referred to as “commuter rail.” When operated between major cities, the service is referred to as “intercity rail.” Amtrak operates virtually all intercity trains in the United States. The two primary types of Passenger Rail trains are locomotive hauled trains and multiple unit trains. Locomotive hauled trains use locomotives to pull cars, while multiple unit train cars each have a driving motor. The grades in the Corridor would require multiple locomotives to pull each train.

- **Advanced Guideway Systems** consist of emerging technologies such as magnetic levitation systems and monorail. Magnetic levitation systems, which rely upon magnets for lift and propulsion, have been under development since the 1960s. Several magnetic levitation systems are currently operating, although the technology is still developing. Monorail systems use a single elevated beam to carry a train over ground-based obstructions. Train vehicles can ride above the beam, hang from the beam, or run on the beam. Monorail systems are operated similarly to Heavy Rail Transit since they are grade separated and cannot run in mixed traffic. Monorails have been operational since the 1950s but have not been used in a corridor as long or remote as the I-70 Mountain Corridor.

4.4.2 Alternative Elements Evaluated

The I-70 Mountain Corridor PEIS considered more than 40 alternative elements related to these four applications. The alternative elements, listed below, consist of combinations of different types of propulsion (electric and diesel), track capacity (single and double-track), and grade considerations (maximum grades of 4 percent, 6 percent, and 7 percent/highway grade); three passenger railroad alternative elements involve new service on existing lines.

Automated Guideway Transit

- AGT using conventional rail with electric traction on single-track or double-track
- AGT using conventional rail with linear induction motor on single-track or double-track
- AGT using concrete guideway with electric traction on single guideway or double guideway
- AGT using monorail with electronic traction on single beam or double beam

Rail

- Diesel Light Rail Transit, single-track – 4 percent
- Diesel Light Rail Transit, single-track – 6 percent
- Diesel Light Rail Transit, single-track – 7 percent
- Diesel Light Rail Transit, double-track – 4 percent
- Diesel Light Rail Transit, double-track – 6 percent
- Diesel Light Rail Transit, double-track – 7 percent
- Electric Light Rail Transit, single-track – 4 percent
- Electric Light Rail Transit, single-track – 6 percent
- Electric Light Rail Transit, single-track – 7 percent
- Electric Light Rail Transit, double-track – 4 percent
- Electric Light Rail Transit, double-track – 6 percent
- Electric Light Rail Transit, double-track – 7 percent
- Diesel Heavy Rail Transit, single-track – 4 percent
- Diesel Heavy Rail Transit, single-track – 6 percent
- Diesel Heavy Rail Transit, double-track – 4 percent
- Diesel Heavy Rail Transit, double-track – 6 percent
- Electric Heavy Rail Transit, single-track – 4 percent

- Electric Heavy Rail Transit, single-track – 6 percent
- Electric Heavy Rail Transit, double-track – 4 percent
- Electric Heavy Rail Transit, double-track – 6 percent

Passenger Railroad

- Diesel locomotive hauled Passenger Railroad, single-track – 4 percent
- Diesel locomotive hauled Passenger Railroad, single-track – 6 percent
- Diesel locomotive hauled Passenger Railroad, double-track – 4 percent
- Diesel locomotive hauled Passenger Railroad, double-track – 6 percent
- Electric locomotive hauled Passenger Railroad, single-track – 4 percent
- Electric locomotive hauled Passenger Railroad, single-track – 6 percent
- Electric locomotive hauled Passenger Railroad, double-track – 4 percent
- Electric locomotive hauled Passenger Railroad, double-track – 6 percent
- Electric Multiple Unit Passenger Railroad, single-track – 4 percent
- Electric Multiple Unit Passenger Railroad, single-track – 6 percent
- Electric Multiple Unit Passenger Railroad, double-track – 4 percent
- Electric Multiple Unit Passenger Railroad, double-track – 6 percent
- Moffat Tunnel to Winter Park Diesel Locomotive hauled Passenger Railroad
- Moffat Tunnel to Glenwood Springs Diesel Locomotive hauled Passenger Railroad
- Intermountain Connection (expanding service on existing tracks to provide passenger service between Vail and the Eagle County Regional Airport)

Advanced Guideway System

- Electric Conventional Monorail Advanced Guideway System, double guideway – 4 percent
- Electric Conventional Monorail Advanced Guideway System, double guideway – 6 percent
- Electric Conventional Monorail Advanced Guideway System, double guideway –7 percent
- Magnetic Levitation Advanced Guideway System – 7 percent

To evaluate and narrow these to a representative range of transit alternative elements appropriate for the Corridor, three stages of evaluation were completed: Level 1, Level 2, and Level 3. The first two levels of screening for Fixed-Guideway Transit alternative elements focused primarily on feasibility issues, and the third screening provided supplemental data for alignments, technical details, and environmental studies. Ultimately, two Fixed-Guideway Transit alternative elements were advanced for evaluation in the I-70 Mountain Corridor PEIS: Rail (electric Heavy Rail Transit) combined with the Intermountain Connection and Advanced Guideway System. Both operate on the highway alignment with maximum 7 percent grades.

4.4.3 Level 1 Screening

Level 1 screening criteria (for all transit alternative elements, including Fixed-Guideway Transit and Rubber Tire Transit) focused on project needs: increased capacity, improved accessibility, and mobility, and decreased congestion in the Corridor. Additionally, safety was evaluated for Fixed-Guideway Transit alternative elements because all would introduce a new mode of transportation into the Corridor. At this first level of screening, criteria were general and not modeled for ridership or real world capacity but provided a way to compare alternative elements and eliminate those clearly not appropriate for the Corridor based on project needs or safety. Because operational modeling and alignment design was limited at this stage, evaluation focuses on the relative benefits and limitations of each of the technologies. **Appendix B**, *I-70 Mountain Corridor Transit Alternatives*, provides additional details on the Level 1 screening process and results.

- **Capacity** is defined as sufficient capacity to have a meaningful impact on congestion, either in number of vehicles removed from the roadway or measurably shortening the length of congested periods. Transit capacity is measured by the theoretical maximum capacity of each transit alternative element, specifically the number of passengers served by each (based on a general consideration of the size or capacity of vehicles and the number of vehicles that can be operated in the travelway).
- **Mobility** is defined by the ease of movement of people and goods within the corridor. Mobility is evaluated by considering the total volumes of people and tons of freight moving through the Corridor, the length of time necessary to traverse the corridor, the level of service to and access of local Corridor communities, and the availability of appropriate and adequate transportation options within the Corridor. For Level 1 screening, mobility was defined as the ability of a transit alternative element to maintain an average vehicle operating speed and achieve a total travel time (including loading and dwell times) reasonably comparable to the automobile. To affect capacity on the highway, transit travel times need to be comparable or better than automobile travel times to create a measurable shift to transit and meet the purpose and need to improve capacity on the highway. In addition, the mobility criterion included a judgment as to the likely level of access to corridor communities that can be achieved by each alternative element.
- **Safety** at Level 1 screening focused on whether the transit alternative element can respond to and adequately handle issues of passenger safety and security, including being able to identify and avoid potential problems. This is measured by whether or not there is an operator physically operating the vehicle in the Corridor to deal with incidents or issues as they arise.

Level 1 screening eliminated Automated Guideway Transit based on the safety criterion because by definition the automated technologies operate without a driver, a condition that was determined inappropriate for the remoteness of the Corridor and the weather, wildlife, and other obstacles that would be encountered along the route. Technologies used for longer distance versions of these systems (with drivers) were evaluated as part of the Heavy Rail Transit and Advanced Guideway System elements. While capacity and mobility factors were considered and ranked for all the alternative elements, none of the Fixed-Guideway Transit alternative elements were eliminated or advanced on these factors at the Level 1 screening. Level 1 screening made some observations about operational characteristics and appropriateness of technologies, and no technologies were eliminated at the first level based on operational performance criteria, such as capacity or mobility. Safety was the primary consideration for eliminating alternative elements at Level 1, and detailed performance analysis of capacity and mobility occurred in Level 2.

4.4.4 Level 2 Screening

After eliminating Automated Guideway Transit, Level 2 screening considered the remaining Fixed-Guideway Transit alternative elements in three categories: rail (Light Rail Transit and Heavy Rail Transit), passenger railroads, and advanced guideway systems. Because of the differences in the ability of modes to operate on different grades, along with the widely varying capital costs, the Fixed-Guideway Transit systems were evaluated on alignments with various maximum grades and considered both single and double-track operations. The highway alignments would be built within or near the existing I-70 highway, which contains grades up to approximately seven percent (for approximately 12 miles near the Eisenhower-Johnson Memorial Tunnels). To address limitations of technologies to handle the steep highway grade, alignments with grades of 4 percent and 6 percent were developed in more detail at this stage; these alignments leave the highway for much of their routes to maintain consistent grades and as a result require substantial tunneling and acquisition of right-of-way. Three alternative elements relying on existing rail (Union Pacific Railroad) corridors were evaluated for new or expanded passenger rail service: the Intermountain Connection providing service from Vail to the Eagle County Regional Airport and service to Winter Park and Glenwood Springs from Denver through the Moffat Tunnel.

The Level 2 screening focused on solutions to the Corridor's many constraints:

- Grades limit vehicle performance
- Curves limit speed
- Right-of-way size limits land available for infrastructure
- Mountain climate and terrain limit choice of power systems

Each of these constraints was evaluated in more detail in the Level 2 Screening. The focus of the evaluation was to develop alternative elements that ensure the most effective and efficient combination of recommended Corridor improvements.

The RAILSIM 7 Train Performance Calculator was used to model train performance for the Fixed-Guideway Transit alternative elements. The tool was used to generate detailed performance characteristics of trains (and buses) operating over a specified alignment. Among the many types of output, the performance data include time, distance, and velocity and acceleration on grades. Inputs for most of the alternative elements were based on real world performance data for the specific technology and vehicles proposed. Some of the parameters for the magnetic levitation advanced guideway system were estimated because empirical data are not available.

The alternative elements that serve the entire Corridor (except the Winter Park and Glenwood Springs alternative elements) assumed station stops at Vail, Copper Mountain, Frisco, Silverthorne, Loveland, Georgetown, Empire, Idaho Springs, US 6, El Rancho, Jefferson (C-470), Denver Union Station, and Denver International Airport. Station dwell time was assumed to be 45 seconds at all stations except Denver International Airport, where a 2 minute dwell (loading and unloading) time was assumed. (The Denver stations are assumed to be provided by the Regional Transportation District or others and are not part of the I-70 Mountain Corridor alternatives but were modeled to provide a better understanding of ridership.) A general operating plan assumes service from 5:00 am to 11:00 pm, seven days per week every day of the year with headways of 20 to 30 minutes. **Appendix C**, *I-70 Mountain Corridor PEIS (Transit) Level 2 Screening*, contains additional details about the operating plan and the Train Performance Calculator model and its results.

The same general categories of criteria were evaluated in Level 2 screening as in Level 1 but the measures were refined to correlate the data more accurately to the operating conditions in the Corridor (using the Train Performance Calculator). Specifically, at the Level 2 screening, alternative elements were eliminated if they could not meet minimum passenger capacity requirements of 2,000 people per hour per direction, could not meet an average speed requirement of 35 miles per hour (mph), or could not operate at least at a 4 percent maximum grade. The passenger capacity threshold represents the capacity required to shift a meaningful portion of Corridor traffic to transit and result in measurably reduced traffic congestion in the Corridor. (The capacity threshold was revised in Level 3 screening to equate to a 25 percent mode shift or 4,200 passengers per hour per direction based on 2030 traffic projections or 4,900 passengers per hour per direction based on 2035 traffic projections.) At the Level 2 screening, passenger capacity was measured by physical capacity of the trains. Detailed ridership projections to determine if demand supported the mode shift were not conducted at this stage. The average speed requirement was set to attract transit riders with a reasonable travel time that would be competitive with automobile travel times in the Corridor. Under congested conditions, automobiles could travel from C-470 to Dotsero in 3.5 hours. (Dotsero was chosen as the end point in the initial screening because existing trackage runs west from Dotsero to Glenwood Springs and Grand Junction.) In order for Fixed-

Guideway Transit to be an attractive alternative, it needs to meet or exceed the automobile Corridor travel times, equating to approximately 35 mph over the course of the 127 miles from C-470 to Dotsero.

The Level 2 screening process also collected and compared data for other factors, including implementation, environmental sensitivity, and community values. Implementation includes consideration of capital costs, operating costs, energy usage, and feasibility issues related to Corridor operations, such as how snow removal could be managed. Environmental sensitivity considered a range of environmental resources, including air quality, waters of the U.S. and wetlands, fish habitats, wildlife habitats, threatened and endangered species, and geologic hazards. Community values considered noise impacts, community impacts, recreation resources, cultural resources, and visual resources. For each of the values considered, performance of the alternative elements is rated from best to worst. Generally, the ratings did not vary substantially among the alternative elements, although some differences were revealed, such as electric trains, which scored much better than diesel trains for minimizing noise impacts and the highway alignment grade (7 percent), which has measurably fewer wetland impacts.

While implementation, environmental, and community factors were considered and ranked for all the alternative elements, none of the Fixed-Guideway Transit alternative elements were eliminated or advanced solely on these factors. The primary considerations for eliminating or advancing alternative elements at Level 2 remained consideration of the project capacity and mobility needs and the suitability of Fixed-Guideway Transit alternative elements to meet those needs. These secondary factors were used to refine alignments (such as expanding footprints of alternative elements to accommodate snow removal recommendations) and eliminate off-highway grade alignments.

Level 2 screening eliminated the following categories of alternative elements:

- Passenger Railroad alternative elements using locomotive-hauled trains (either diesel or electric) could not operate reliably in the Corridor. Simulator calculations conducted for Level 2 screening (see **Appendix C**, *I-70 Mountain Corridor PEIS Level 2 [Transit] Screening*) confirmed the expectation raised in Level 1 screening that locomotive-hauled passenger trains could not operate at the grades prevalent throughout the Corridor. **Appendix D** (*Maximum Gradients for Fixed-Guideway Transit Systems [Except Monorail] Proposed for the I-70 Mountain Corridor*) contain additional details on Fixed-Guideway Transit and grade limitations. Most passenger railroad systems are designed to operate with a maximum two percent grade on the mainline, and few operate long distances at steeper grades (**Appendix C**, *I-70 Mountain Corridor PEIS Level 2 [Transit] Screening*). The corridor contains approximately 37 miles of moderate grades (between 3 and 6 percent) and 12 miles of steep grades (more than 6 percent). Operational analysis conducted using the Train Performance Calculator confirmed that the alignment curvature and limitations on the braking/acceleration of the locomotive-hauled trains exacerbated the grade problems and that this technology could not operate reliably even at 4 percent grades (**Appendix C**, *I-70 Mountain Corridor PEIS Level 2[Transit] Screening*).
- Passenger Railroad alternative elements expanding service to Winter Park and Glenwood Springs were eliminated because of low capacity (approximately 1,400 passengers per hour) and slow travel speeds (23 to 27 miles per hour).
- Diesel Heavy Rail Transit at 6 percent grade alignment could not meet minimum average speed requirements and was eliminated. The modeled average speed for the diesel Heavy Rail Transit 6 percent alternative element was 33 mph.
- Single-track alternative elements have inadequate capacity to relieve congestion on the I-70 highway and were eliminated. The passenger capacities for single-track alternative elements ranged from 1,320 to 1,416 passengers per hour, well below the threshold of 2,000 passengers per hour set for Level 2 screening. (As noted previously, the thresholds were raised in Level 3 screening to reflect updated travel demand modeling that occurred during the screening process,

but the single-track alternative elements failed to meet even the lower threshold considered in Level 2.) This limitation screened out the single-track Light Rail Transit (diesel and electric) and electric Heavy Rail Transit alternative elements (Diesel Heavy Rail Transit and Passenger Railroad single-track alternative elements also fail this measure but are eliminated for other reasons).

- All 4 percent grade alignments were eliminated because operational analyses demonstrated that the remaining alternative elements (diesel and electric Light Rail Transit, electric Heavy Rail Transit, electric multiple unit passenger rail, and Advanced Guideway System) could operate on 6 percent or 7 percent grades. Diesel Heavy Rail Transit on 4 percent grade performed marginally on speed (averaging 38 mph) and was eliminated for this reason and because of the impacts associated with the 4 percent alignment. The 4 percent alignment requires substantial tunneling, which is both expensive and in many cases difficult or severely environmentally damaging to construct and operate. The 4 percent alignment has greater environmental impacts than those calculated for the 6 percent alignment because its flatter grades require more mileage off the existing I-70 alignment and therefore more extensive environmental impacts. **Section 4.9** contains additional information on the tunnel elements. Eliminating the 4 percent grade eliminated the need for the following tunnels:
- Silverthorne Tunnel is approximately 11,500 feet in length located along the north side of the I-70 highway between mileposts 205.5 and 207.7.
- Loveland Pass Tunnel (Snake Creek Alignment) between the Arapahoe Basin and Loveland ski areas uses or expands the pilot bore for the Eisenhower-Johnson Memorial Tunnels. The tunnel is problematic because the approach grades are steep (9 percent to 10 percent) and may be difficult for Fixed-Guideway Transit operations. Additionally, the environmental impacts to the Snake Creek watershed and surrounding wilderness areas are severe, and the U.S. Forest Service strongly objected to a new transportation corridor through the Continental Divide.
- Silver Plume North Tunnel bypasses the town of Silver Plume to the north, with the west portal for the tunnel near the Burleigh (mining) Tunnel and the east portal located east of the Georgetown interchange. This tunnel encounters unstable soils and unknown mine workings. Mine workings encountered during construction require mitigation to prevent collapse and also could open a conduit for mine wastes to enter water.
- Georgetown Incline Fixed-Guideway Transit Tunnel is a 2.6-mile tunnel located between Georgetown and Silver Plume interchanges at approximately mileposts 226.6 to 228.2.
- Mount Vernon Canyon Tunnel is a 6.2-mile-long tunnel beginning at C-470.

After the Level 2 screening, six alternative elements were recommended for further evaluation in Level 3 screening:

- **Diesel Light Rail Transit, double-track, highway alignment/ 7 percent grade.** This alternative element has an estimated peak hour capacity of 2,932 passengers and a simulated average speed of 46.1 mph.
- **Electric Light Rail Transit, double-track, highway alignment/ 7 percent grade.** This alternative element has an estimated peak hour capacity of 2,640 passengers and a simulated average speed of 48.6 mph.
- **Electric Heavy Rail Transit, double-track, 6 percent grade.** This alternative element has an estimated peak hour capacity of 9,240 passengers and a simulated average speed of 44.6 mph.
- **Electric Multiple Unit Passenger Railroad, double-track, 6 percent grade.** This alternative element has an estimated peak hour capacity of 9,636 passengers and a simulated average speed of 42.8 mph.

- **Electric Conventional Monorail Advanced Guideway System, double guideway, highway alignment/7 percent grade.** This alternative element has an estimated peak hour capacity of 10,000 passengers and a simulated average speed of 65.8 mph.
- **Magnetic Levitation Advanced Guideway System, highway alignment/7 percent grade.** This alternative element has an estimated peak hour capacity of 8,400 and a simulated average speed of 57.1 mph.

4.4.5 Level 3 Screening

The alternative elements advanced to Level 3 screening were further analyzed and developed to confirm their reasonableness as candidates for the Corridor. Level 3 screening relied on a number of studies related to alignments, technical analyses (cost and travel performance), conceptual engineering, tunnel studies, environmental and community impact assessment, and travel demand projections. Engineering studies were conducted to refine the proposed alignments and footprints for those alternative elements advanced for full consideration in the PEIS.

Like the previous levels of screening, Level 3 screening focused on confirming that alternative elements could meet project needs, primarily related to passenger capacity and average speeds, which were used as measures of whether Fixed-Guideway Transit could alleviate congestion and improve safety (by reducing congestion) in the Corridor.

The primary purpose of the Level 3 screening was to advance a range of alternative elements that are representative of Fixed-Guideway Transit that could be constructed and operated in the Corridor. The feasibility and operational analyses conducted in the Level 1 and Level 2 screenings provide data about the relative performance characteristics of each technology and their suitability to operate in the Corridor. The Fixed-Guideway Transit alternative elements advanced from Level 2 screening represent two primary categories: Rail and Advanced Guideway System. The Rail transit alternative elements were analyzed to determine the best performing rail system and advance that system as a representative rail system for consideration. The Advanced Guideway System category uses the magnetic levitation technology as the representative alternative element of an Advanced Guideway System that could operate in the Corridor; conventional monorail may be revisited in Tier 2 processes. Both Rail and Advanced Guideway System were advanced for detailed analysis in the PEIS to confirm that they could work if selected as a preferred alternative, define general footprints so that environmental impact analysis could proceed, and provide reasonable assumptions about operating characteristics and implementation requirements so that the Fixed-Guideway Transit alternatives are compared to other Action Alternatives considered in the PEIS.

Performance of the four rail modes (diesel and electric light rail transit, electric heavy rail transit, and electric multiple unit passenger railroad) was evaluated to determine the best rail system that could be advanced in the PEIS. Electric Heavy Rail Transit technology was refined with regard to size, power needs, speeds, and amenities and found to best meet the specific needs of the Corridor. The Light Rail Transit elements were eliminated because of their lower capacity (less than 3,000 passengers per hour) compared with the Heavy Rail Transit elements. The Level 3 screening criteria for capacity, based on refined travel demand modeling and a threshold of 4,900 passenger per hour, was determined necessary to affect congestion in the Corridor in a meaningful way (by shifting 25 percent of traffic to transit in 2035). Because Light Rail Transit elements did not have the physical capacity (i.e., number of seats) to serve this number of passengers, they were eliminated. The Passenger Railroad Electric Multiple Unit element was also less desirable because the advantage of operating as part of the national railroad system was removed because a rail line with either a 6 percent or 7 percent maximum grade could not be operated with FRA-compliant vehicles, such as the Passenger Railroad Electric Multiple Unit vehicle. The Passenger Railroad Electric Multiple Unit has similar capacity to the Heavy Rail Transit but slower operating speeds and much heavier weights (thus using more energy to operate). This alternative element was not advanced as the representative rail alternative but was retained and could be reconsidered in Tier 2 processes (as technologies may improve and make this alternative element more attractive). For additional information see **Appendices C and D** (*I-70 Mountain Corridor PEIS Level 2 Screening* and *Maximum Gradients for Fixed-Guideway Transit Systems [Except Monorail] Proposed for the I-70 Mountain Corridor*, respectively) and **Section 4.9** (Tunnels).

Finally, the Rail alignment was modified from 6 percent maximum grade to the highway alignment, which contains areas of grades approaching 7 percent. Eliminating the 6 percent grade avoids some tunneling (particularly the Georgetown Incline Tunnel) and environmental impacts resulting from the off-highway alignments. Rail alternatives using the 6 percent alignment require approximately 29.4 miles off the existing I-70 highway alignment. When compared with the Heavy Rail Transit Alternative using the I-70 highway alignment, the footprint for the 6 percent alignment results in substantially greater impacts for the following resources:

- Wetlands – more than twice the number of acres of wetlands with the 6 percent alignment (41.29 acres on the highway alignment compared with 89.8 acres on the 6 percent grade)
- Fen wetlands – none on the highway grade compared to 0.10 acres on the 6 percent alignment
- Stream disturbance – more than one additional mile of impact (33,461 linear feet with the highway alignment compared to 39,408 linear feet with the 6 percent grade)
- Private parcels – more than twice as many parcels crossed by the 6 percent alignment (237 parcels compared to 555 parcels)
- United States Forest Service lands – more than five-times as many acres of Forest Service lands (5.7 acres compared with 58.5 acres with the 6 percent alignment)
- Total acres potential footprint impacts outside the I-70 highway right-of-way (52.6 acres compared with 300 surface acres)

The Train Performance Calculator modeling confirmed that the Heavy Rail Transit alternative element developed for Level 2 screening could handle the occasional short segments of 7 percent grades of the highway alignment with only minor degradation of performance and meets the minimum speed and capacity thresholds (**Appendix D**, *Maximum Gradients for Fixed-Guideway Transit Systems [Except Monorail] Proposed for the I-70 Mountain Corridor*). Because of the desire to optimize the Rail alternative element and the relatively better performance of the Heavy Rail Transit trains, the Heavy Rail Transit technology was modeled and advanced as the representative, best performing rail technology and, combined with the Intermountain Connection, was advanced as the Rail with Intermountain Connection Alternative in the PEIS.

The Advanced Guideway System alternative elements were advanced into a single category. For the purposes of the PEIS, a magnetic levitation system was assumed, and the Federal Transit Administration's Urban Maglev System is used in the PEIS to represent the Advanced Guideway System. The data considered confirm that, based on current information and development trends, an Advanced Guideway System could be feasible in the Corridor (**Appendix D**, *Maximum Gradients for Fixed-Guideway Transit Systems [Except Monorail] Proposed for the I-70 Mountain Corridor*). The actual technology would be defined in a Tier 2 process, and it is recognized that further testing and analysis is needed before any Advanced Guideway System could be implemented. Regardless of the technology, the Advanced Guideway System would be a high-speed, fully elevated Fixed-Guideway Transit system.

4.4.6 Summary

Three levels of screening and analysis conducted resulted in two Fixed-Guideway Transit alternatives being developed for consideration in the PEIS. The alternatives represent the two types of Fixed-Guideway Transit determined to be feasible for operation in the Corridor and have the best opportunity to meet purpose and need: Rail and Advanced Guideway System. **Table 6** presents a summary of the screening process and its results. The table presents the alternative elements considered and the results of each level of screening.

Table 6. Fixed-Guideway Transit Alternative Elements

Fixed-Guideway Transit Alternative Element	Screened – Level 1 Screening	Screened – Level 2 Screening	Screened – Level 3 Screening	Advanced for Action Alternative Development
Existing I-70 Highway Alignment (7% Grade) – Diesel Power				
Light Rail Transit – Single-track		X		
Light Rail Transit – Double-track			X	
Existing I-70 Highway Alignment (7% Grade) – Electric Power				
Light Rail Transit – Single-track		X		
Light Rail Transit – Double-track			X	
Advanced Guideway System				✓
Automated Guideway Transit	X			
Heavy Rail Transit – Double-track (Moved from 6% Alignment) (milepost 176–260)				✓
6% Grade Alignment – Diesel Power				
Light Rail Transit – Single-track		X		
Light Rail Transit – Double-track		X		
Heavy Rail Transit – Single-track		X		
Heavy Rail Transit – Double-track		X		
Passenger Railroad – Locomotive Hauled – Single-track		X		
Passenger Railroad – Locomotive Hauled – Double-track		X		
6% Grade Alignment – Electric Power				
Light Rail Transit – Single-track		X		
Light Rail Transit – Double-track		X		
Heavy Rail Transit – Single-track		X		
Passenger Railroad Electric Multiple Unit – Single-track		X		
Passenger Railroad Electric Multiple Unit – Double-track			X	
4% Grade Alignment – Diesel Power				
Light Rail Transit – Single-track		X		
Light Rail Transit – Double-track		X		
Heavy Rail Transit – Single-track		X		
Heavy Rail Transit –- Double-track		X		
Passenger Railroad – Locomotive Hauled – Single-track		X		
Passenger Railroad – Locomotive Hauled – Double-track		X		

Table 6. Fixed-Guideway Transit Alternative Elements

Fixed-Guideway Transit Alternative Element	Screened – Level 1 Screening	Screened – Level 2 Screening	Screened – Level 3 Screening	Advanced for Action Alternative Development
4% Grade Alignment – Electric Power				
Light Rail Transit – Single-track		X		
Light Rail Transit – Double-track		X		
Heavy Rail Transit – Single-track		X		
Heavy Rail Transit – Double-track		X		
Passenger Railroad Electric Multiple Unit – Single-track		X		
Passenger Railroad Electric Multiple Unit – Double-track		X		
Existing Rail Facility				
Intermountain Connection (milepost 142–176)				✓
Passenger Railroad – Winter Park Service Track		X		
Passenger Railroad – Glenwood Springs Service Track		X		

Key to Abbreviations/Acronyms:
AGS = Advanced Guideway System HRT = heavy rail transit IMC = Intermountain Connection
LRT = light rail transit

4.5 Rubber Tire Transit

4.5.1 Introduction

Rubber Tire Transit alternative elements focus on bus operations. Buses are self-powered vehicles designed for commercial use, capable of operating on roadways, and carrying more than six passengers. In this study, buses are defined as traditional over-the-road coach design suitable for long-distance travel, and vans carry six passengers or less.

Bus alternative elements were categorized by propulsion type, facility use, and direction of facility operation.

Propulsion type: Fuel types may be diesel, gasoline, compressed natural gas, propane, or other available alternates. Buses may also use electric propulsion (called electric buses) or a combination of electric propulsion and self-generated fuel power (called dual-mode buses). Electric buses can only operate within a dedicated facility that contains overhead or road-based power lines and cannot travel on regular roads. Dual-mode buses can operate using electricity in a dedicated facility and switch to diesel power to travel on regular roads.

Facility Use: Rubber Tire Transit alternative elements may operate in four different roadway environments: mixed traffic, high occupancy vehicle/high occupancy toll (HOV/HOT) lanes, transitways, and guideways.

- Operation in mixed traffic means the bus travels with regular traffic on the I-70 highway.
- Operation in HOV/HOT lanes means the bus travels in lanes intended only for buses, carpools, or low-occupancy vehicles that have paid a toll. The lanes may be separated from regular traffic

lanes either by painted markings on the road (called a "marked HOV lane") or by physical barriers (called a "barrier-separated HOV lane").

- Operation in a transitway means the bus operates on a completely separate road, limited to transit vehicles only that may or may not be adjacent to regular travel lanes.
- Operation in a guideway means the bus operates on a transitway containing special guide rails to guide the bus. Guideways reduce lane width requirements and allow increased speeds, since the bus is steered by the guide rails.

Direction of Facility Operation: All bus operations except mixed traffic were considered for "peak-direction only" and "both direction" operation. Peak-direction only operation means a single-lane facility provides service only in the direction of peak traffic, and buses traveling in the non-peak direction use regular traffic lanes. Both direction operation means a two-lane facility provides service in both directions, and buses do not operate in regular traffic lanes at all.

4.5.2 Alternative Elements Evaluated

The lead agencies considered many variations of Rubber Tire Transit alternative elements. Some elements were later combined for ease of evaluation (for instance, buses of different propulsion types operating in HOV lanes were combined into a single "Bus in HOV" alternative element). As a result, the PEIS presents four sets of Rubber Tire Transit alternative elements. The lead agencies grouped the following 15 initial alternative elements by facility type. The origin and final destination points of the alternative elements changed throughout the different levels of screening and are described at the end of this **Section 4.5.2**. All alternative elements in transitways or guideways were considered for bus rapid transit (BRT) on-line stations located in the median of the transitway or guideway.

Bus or Van in Mixed Traffic

This alternative element includes buses or vans operating in the regular travel lanes on the I-70 highway.

Bus in HOV Lane

The Bus in HOV Lane alternative element includes the following four variations:

- Diesel bus in marked HOV lane, peak direction only
- Diesel bus in marked HOV lane, both directions
- Diesel bus in barrier-separated HOV lane, peak direction only
- Diesel bus in barrier-separated HOV lane, both directions

Buses travel in either marked HOV lanes (that is, separated from regular travel lanes by painted markings on the road) or in barrier-separated HOV lanes (that is, with physical barriers separating the HOV lanes from the regular travel lanes). Buses in barrier-separated HOV lanes are less prone to traffic disruptions than those in marked lanes because the limited access points make it more difficult for drivers to illegally enter the lanes. For peak direction only operations, buses travel in the peak direction in the HOV lane, which is intended for buses and carpools only. Buses traveling in the non-peak direction use regular travel lanes. For both direction operations, buses travel in both peak and non-peak directions in the HOV lanes. Buses have some speed advantage over traffic in general purpose lanes, because HOV lanes generally are less congested and maintain higher speeds during peak hours than general purpose lanes.

Bus in Transitway

The Bus in Transitway alternative element includes the following five variations:

- Diesel bus in transitway, peak direction only
- Dual-mode bus in transitway, peak direction only

- Diesel bus in transitway, both directions
- Dual-mode bus in transitway, both directions
- Electric bus in transitway, both directions

For peak direction only operations, buses travel in the peak direction in the transitway, dedicated exclusively to transit vehicles. Buses traveling in the non-peak direction use regular travel lanes. For both direction operations, buses travel in both peak and non-peak directions in the transitway. Buses traveling in the transitway typically operate at or above the posted speed limits on the I-70 highway since the transitway is used only by professional drivers and is not subject to traffic congestion. Steep mountain grades limit speeds of diesel buses, but do not limit speeds of dual-mode and electric buses during periods of electric power use in the transitway. Electric buses do not travel outside of the transitway to access other points in the Corridor because they do not operate without their power source (either an overhead wire or a power rail in the roadway).

Bus in Guideway

The Bus in Guideway alternative element includes the following five variations:

- Diesel bus in guideway, peak direction only
- Dual-mode bus in guideway, peak direction only
- Diesel bus in guideway, both directions
- Dual-mode bus in guideway, both directions
- Electric bus in guideway, both directions

These are the same as those listed under the Bus in Transitway, except the buses travel in a guideway instead of a transitway. The guideway steers the bus by a device that tracks the edge of the guideway, allowing a narrower facility width and even higher speeds than the transitway. Steep mountain grades still limit speeds for diesel buses and dual-mode buses during periods of diesel power use.

The lead agencies made the following assumptions about bus operations, providing a consistent basis for evaluation and comparison. Bus routes may provide express service (for example, C-470 to Vail with no or limited intermediate stops) or local service by stopping at each proposed station. In Level 1 screening, alternative elements were analyzed for service between the I-70/C-470 park-n-Ride and Dotsero. In Level 2 screening, alternative elements were analyzed for service from Denver International Airport, downtown Denver, and the I-70/C-470 Park-n-Ride to points along the Corridor (Evergreen/US 6, Idaho Springs, Empire, Loveland, Silverthorne, Keystone, Frisco, Copper, and Vail). In Level 3 Screening, alternative elements were studied for service from Denver International Airport, Denver Union Station, north metro area, and south metro area to numerous communities and ski resorts along the Corridor, with service terminating in Glenwood Springs. In Level 3 screening, the Rubber Tire Transit alternative elements were modified to terminate in Vail for consistent comparison with the Fixed-Guideway Transit alternative elements. For the Level 2 and Level 3 screenings, operations plans were developed with a variety of different local and express routes serving these different locations. Finally, those alternative elements evaluated in the PEIS were analyzed for service between C-470 and the Eagle County Regional Airport. This provides comparable service to the Fixed-Guideway Transit alternative elements, and provides an intermodal connection between aviation and transit service in the region.

4.5.3 Level 1 Screening

Level 1 screening criteria for transit (both rubber tire and fixed guideway) focused on project needs: increased capacity, improved accessibility and mobility, and decreased congestion in the Corridor. Additionally, safety was evaluated because a new mode of transportation is introduced in the Corridor. At this first level of screening, criteria are general and not modeled for ridership or real world capacity, but provide a way to compare alternative elements and eliminate those that are clearly not appropriate for the Corridor based on project needs or safety. Because neither operational modeling nor alignment design was conducted at this stage, evaluation focused on the relative benefits and limitations of each alternative element.

Capacity is defined as sufficient capacity to have a meaningful impact on congestion, either in number of vehicles removed from the roadway or measurably shortening the length of congested periods. Transit capacity is measured by the theoretical maximum capacity of each transit alternative element. The maximum theoretical passengers per hour per direction was determined by multiplying the average speed of the vehicle with the maximum capacity of the vehicle and the maximum number of vehicles that could be operated within the travel way within a set time frame. This equation substantially overstates real-world capacity, but provides a valid comparison among Rubber Tire Transit alternative elements. This analysis cannot be used to compare these alternative elements against Fixed-Guideway Transit alternative elements, which used a different method of measurement.

Mobility is defined by the ease of movement of people and goods within the Corridor. Mobility can be evaluated by considering the total volumes of people and tons of freight moving through the Corridor, the length of time necessary to traverse the Corridor, the level of service to and access of local Corridor communities, and the availability of appropriate and adequate transportation options within the Corridor. For Level 1 screening, mobility is defined as the ability of a transit alternative element to maintain an average vehicle operating speed and achieve a total travel time (including loading and dwell times) reasonably comparable to the automobile. This equates to a travel time from C-470 to Dotsero in less than 3.5 hours, or an average speed of 35 mph. (Dotsero was selected as an initial endpoint to be consistent with the Fixed-Guideway Transit alternative elements; this end point was selected for the Fixed Guideway Transit to preserve future expansion, as existing trackage is present from this point west to Glenwood Springs and Grand Junction.) In addition, the mobility criterion included a judgment as to the likely level of access to Corridor communities that can be achieved by each alternative element.

Safety at Level 1 screening focuses on whether the alternative element can respond to and adequately handle issues of passenger safety and security, including being able to identify and avoid potential problems. Safety was measured for all fixed guideway and rubber tire transit alternative elements by whether or not there is an operator physically operating the vehicle in the Corridor to deal with incidents or issues as they arise.

All Rubber Tire Transit alternative elements were advanced to Level 2 screening for further evaluation. Initially the Bus in HOV Lanes, Both Directions alternative element were eliminated because the Bus in HOV Lanes, Peak Direction Only provides adequate capacity with a narrower footprint and thus fewer impacts to resources and lower costs. However, at the request of the advisory committees, the Bus in HOV Lanes, Both Directions alternative element was retained for Level 2 screening.

About half of the alternative elements meet the average speed threshold of 35 mph, or 3.5 hours between C-470 and Dotsero, with station stops. All of the alternative elements operating in a transitway or guideway in both directions, plus the Dual-Mode Bus in Transitway, Peak Direction Only alternative element, meet the average speed threshold. The remaining alternative elements achieve average speeds ranging between 25 and 35 mph. See **Appendix J**, *I-70 Mountain Corridor Programmatic Environmental Impact Statement Level 1 Screening Report—Appendix A*, for values for each alternative element. Although the other alternative elements do not meet the average speed threshold, the advisory committees requested the alternative elements advance to Level 2 screening for more detailed operations analyses. All of the alternative elements provide access to 100 percent of Corridor communities.

4.5.4 Level 2 Screening

Level 2 screening focused on criteria related to the purpose and need for the project, implementation, environmental impacts, and community values. The Level 2 screening criteria did not focus on eliminating alternative elements if they did not meet certain thresholds, but rather compared alternative elements to each other to screen out those with less ideal operational characteristics. Because the screening was based primarily on operational characteristics related to the purpose and need, only those criteria relevant to the elimination or advancement of alternative elements are discussed in this section. For information on implementation, environmental impacts, and community values criteria, see **Appendices C and F** (*I-70 Mountain Corridor PEIS Level 2 Screening* and *I-70 Mountain Corridor PEIS Level 2 Screening Alternatives Comparison*, respectively).

The lead agencies used five measures to evaluate the remaining alternative elements:

- Peak hour system capacity,
- System attractiveness,
- Average speed,
- Connectivity to existing or planned systems, and
- Feeder/distribution requirements.

A comparison of system safety among the alternative elements was also analyzed.

Peak hour system capacity measures the maximum number of passengers that could be carried in the peak direction during the peak hour of the day. The theoretical maximum capacity is based on the size of the bus (45-seat diesel bus and 60-seat articulated dual-mode or electric bus) and the conceptual ridership plans, which defines the number of buses operating in the peak hour in the peak direction (see **Appendix C**, *I-70 Mountain Corridor PEIS Level 2 [Transit] Screening*).

The attractiveness of a particular system to riders is qualitatively measured based on average speeds and vehicle comfort and amenities. Average speeds are measured between C-470 and Vail, including the dwell (loading and unloading) time for ten station stops during the trip.

Connectivity to existing or planned systems is measured by the number of transfers required between different transit vehicles. Changes to existing Corridor transit services are required to provide adequate connections between bus stations and destinations. Feeder/distribution requirements are measured by studying the percent change in existing transit vehicle miles from those presently used in the Corridor.

Six of the Rubber Tire Transit alternative elements were advanced to Level 3 screening for further evaluation because they fulfilled all of these criteria, and performed exceedingly well on capacity and average speed criteria:

- Diesel Bus in Transitway, Both Directions, with BRT Stations
- Dual-Mode Bus in Transitway, Both Directions, with BRT Stations
- Diesel Bus in Guideway, Peak Direction
- Diesel Bus in Guideway, Both Directions, with BRT Stations
- Dual-Mode Bus in Guideway, Peak Direction
- Dual-Mode Bus in Guideway, Both Directions, with BRT Stations

The alternative elements range from a maximum theoretical capacity of 24,000 passengers per hour (diesel buses) to 32,000 passengers per hour (dual-mode buses), in the peak direction, at the peak hour. Average speeds between C-470 and Vail, including the dwell time for ten station stops during the trip, ranged from 51 mph (diesel buses) to 64 mph (dual-mode buses with on-line BRT stations).

The remaining nine alternative elements are eliminated, including Bus or Van in Mixed Traffic, all Bus in HOV Lane alternative elements, all electric bus alternative elements, and all Peak Direction Only transitway alternative elements. The performance of the alternative elements against the measures is summarized below and described in detail in **Appendix C**, *I-70 Mountain Corridor PEIS Level 2 (Transit) Screening*.

Bus or Van in Mixed Traffic alternative element. Capacity was shown to be 2,500 passengers per hour in the peak direction during Level 1 screening. The capacity was not re-calculated for the Level 2 screening because capacity is limited to the capacity of the existing roadway, which is already determined insufficient. The Bus in Mixed Traffic alternative element averages only 36 mph because of congestion in the general traffic lanes. Although both the capacity and the speed meet the minimum thresholds established for Level 2 screening (2,000 passengers per hour in the peak direction and 35 mph), they were so much lower than the other alternative elements considered that it was eliminated from further consideration on the basis of comparison. The remaining alternative elements have maximum theoretical capacities ranging from 41,700 to 78,800 passengers per hour in the peak direction. See **Appendix J**, *I-70 Mountain Corridor Programmatic Environmental Impact Statement Level 1 Screening Report—Appendix A*, for values for each alternative element.

- Additionally, due to the low speed, the Bus in Mixed Traffic alternative element does not have competitive travel times and would, therefore, not achieve desired ridership to affect congestion on the highway.
- **Bus in HOV Lanes alternative elements.** These were combined with the Highway HOV alternative element analysis during Level 2 screening. That analysis found that, due to the mixed traffic in the HOV lanes, congestion remains a problem during peak hours and bus capacity is too low. Among Rubber Tire Transit facility types, HOV lanes are considered the least attractive because their speeds and capacity are lower than the other dedicated facility types. This creates a low demand for ridership, and was one of the two criteria used to eliminate the Bus in HOV Lanes alternative elements. The low capacity and low demand for ridership eliminated these alternative elements from further consideration.
- **Electric bus alternative elements.** These elements have poor connectivity in comparison to the other bus alternative elements, because they only operate on roadways with electric power supplies, requiring transfers to other transit services. For this reason, all electric only bus alternative elements were eliminated from further consideration.
- **Diesel Bus and Dual-Mode Bus in Transitway, Peak Direction Only alternative elements.** These elements were eliminated on the basis of comparison to the Both Direction alternative elements, rather than on their ability to meet the screening criteria. The Peak Direction Only alternative elements require nearly as much right-of-way width as the Both Direction alternative elements, and provide less operational flexibility and schedule dependability. Therefore, they were eliminated from further consideration.

4.5.5 Level 3 Screening

The lead agencies made refinements to the six alternative elements advanced to Level 3 screening, and consolidated them into four alternative elements. Rather than operating either in peak direction only or in both directions for the entirety of the Corridor, the four alternative elements operate in peak direction only in some locations, both directions in others, and in mixed traffic in the less-congested western half of the Corridor. This effectively eliminated the remaining peak direction only alternative elements.

The four refined alternative elements are as follows:

- **Diesel Bus in Transitway and Dual-Mode Bus in Transitway.** A transitway operating in both directions constructed between the east portal of the Eisenhower-Johnson Memorial Tunnels and Hyland Hills (the current end of the six-lane configuration of the I-70 highway). Congestion rarely occurs east of Hyland Hills. Bus operation west of the tunnels occurs in mixed traffic.
- **Diesel Bus in Guideway.** This alternative element is the same as the Diesel Bus in Transitway alternative element, except the bus operates in a guideway instead of a transitway.
- **Dual-Mode Bus in Guideway.** A guideway operating in both directions constructed between C-470 and the east portal of the Eisenhower-Johnson Memorial Tunnels. An additional peak direction only transitway, operating in the eastbound direction, is constructed between Silverthorne and the east side of the Eisenhower-Johnson Memorial Tunnels. This allows the dual-mode buses to access the electric power, which is stronger and quieter than diesel power, to climb the approach to the west portal of the Eisenhower-Johnson Memorial Tunnels and Floyd Hill.

No specific criteria were employed to measure the remaining Rubber Tire Transit alternative elements. Rather, a series of studies was conducted to better understand the operational characteristics of the alternative elements and compare them against one another. The alternative element footprints, performance characteristics (including trip time and energy consumption), operating plans, operations costs, and capital costs are documented in **Appendix E**, *I-70 Programmatic Environmental Impact Statement Transit Summary Document*.

The consolidation of the six alternative elements into four eliminated the peak direction only alternative elements from further consideration. After additional evaluation, both guideway alternative elements were identified as being reasonable to evaluate in the PEIS because it has a smaller footprint than the transitway alternative elements. Because guideway alternative elements provide the same level of service as the transitway alternative elements, but with fewer impacts and lower costs, they were advanced and evaluated in the PEIS. However, the transitway alternative elements can be evaluated in more detail in Tier 2.

4.5.6 Alternatives Advanced for Evaluation in the PEIS

Although the transitway alternative elements were initially eliminated after Level 3 studies, they were retained to provide a wider range of bus alternatives for consideration in Tier 2. The Bus in Guideway alternative element is representative of a variety of possible bus operations operating on an exclusive right-of-way. It is assumed reasonable to evaluate Bus in Guideway as representative since this alternative element moves a similar number of people, minimizes impacts with a narrower footprint and has the potential (when combined with the highway alternatives) to meet the 50 year purpose and need.

Additionally, the western terminus of the peak-direction-only portion of the bus in transitway and guideway alternative elements is extended from Silverthorne to the Eagle County Regional Airport. This alternative element provides comparable service to the Fixed-Guideway Transit alternatives, and provides an intermodal connection between aviation and transit services in the region.

While Bus in Mixed traffic was eliminated during the Level 2 screening as a standalone alternative, it was advanced for consideration in the PEIS as part of the Minimal Action Alternative. See **Section 5** for more details about the Minimal Action Alternative. The bus in mixed traffic component operates between C-470 and Glenwood Springs in the Minimal Action Alternative.

Table 7. Rubber Tire Transit Alternative Elements

Rubber Tire Transit Alternative Element	Screened—Level 1 Screening	Screened—Level 2 Screening	Screened—Level 3 Screening	Advanced for Action Alternative Development
Bus in Mixed Traffic		X		
Bus in high-occupancy vehicle Lanes		X		
Bus in Transitway or Guideway—Diesel or Dual-Mode—Both directions (Guideway assumed as most reasonable for evaluation)				✓
Bus in Transitway or Guideway—Diesel or Dual-Mode—Peak direction only		X—Transitway	X—Guideway	
Bus in Transitway or Guideway—Electric		X		

4.6 Highway Improvements

4.6.1 Introduction

The family of Highway Improvements alternative elements focuses on highway widening in areas where it is warranted in the Corridor. These areas were termed problematic areas, and were identified in Level 1 screening. A variety of operational and design alternative elements for highway widening were identified and evaluated, by location within the problematic areas. In locations other than the problematic areas, highway improvements were addressed in the family of Localized Highway Improvements.

4.6.2 Alternative Elements Evaluated

Six primary highway alternative elements that address the problematic areas of the I-70 Mountain Corridor for increasing highway capacity and optimizing operational efficiency are identified and evaluated:

- **Six-lane highway widening.** This alternative element adds an additional travel lane in each direction. An additional tunnel bore is required at the Eisenhower-Johnson Memorial Tunnels and the Twin Tunnels. Several design options were considered for widening the I-70 highway to six lanes:
  - **Horizontal Widening (Standard Shoulders/Variable-width Shoulders/Smart Widening).** This alternative element widens the highway footprint by adding a lane in each direction alongside the existing lanes. A standard design includes 12-foot inside and outside shoulders. A design with variable shoulders includes eight to ten foot shoulders. Smart widening includes less standard shoulder and median width and clear zone distances.
  - **Vertical Widening (Structured Lanes/Cantilevered Lanes/ Tunneled Lanes).** This alternative element largely maintains the existing footprint of the highway by stacking the directional travel lanes vertically. Structured lanes have an elevated section for one direction of traffic. Structured lanes can be stacked or terraced, with the elevated section directly above or cantilevered from one side (called "Cantilevered Lanes"). Tunneled lanes have one direction of travel below grade, with the opposing direction of travel on top. Tunneled lanes are constructed with a "cut and cover" design.
  - **Design Speed (55 miles per hour/65 miles per hour).** Six-lane widening with any of the horizontal options or vertical options provides respective design speeds of 55 and 65 miles

per hour. The 65 miles per hour design speed requires more curve straightening and tunneling but achieves a faster travel time.

- **Flex Lanes.** This alternative element provides for the use of shoulders as traffic lanes during peak hours. During off-peak periods, the Flex lane functions as a wide shoulder. The Flex lane consists of a 12-foot travel lane and a four-foot shoulder, for a total width of 16 feet. Flex lanes are provided in both travel directions. Access to the Flex lanes is controlled by lane closure gates (similar to some of the truck chain-up areas) and variable message signing. Flex lanes are developed by shifting the existing roadway towards the median.
- **Reversible/High Occupancy Vehicle (HOV)/High Occupancy Toll (HOT) Lanes.** This alternative element provides a traffic lane designated to serve multiple functions. The basic concept of this alternative element is to accommodate peak direction traffic flows with a reversible lane. The lane is managed to provide a high Level of Service to a specific user group such as high occupancy vehicle users or high occupancy-toll lane users where single occupant vehicles are tolled and high occupancy vehicles travel at no charge. This alternative element requires the ability to transition from one side of the roadway to the other such as now occurs on north I-25 in the Denver metropolitan area between the I-70 highway and US 36. In the areas where the opposing roadways are at considerably different elevations, a structured transition is required.
- **Movable Median.** This alternative element is a reconstructed five-lane highway with adequate shoulders, with a reversible lane forming a third lane during peak periods using a movable median. A specially equipped vehicle lifts portable barrier segments and shifts them laterally to produce a new lane configuration. The eastbound and westbound directions of the highway need to be on a common plane to allow the movable barrier to be shifted one lane width to accommodate peak directional flow demand.
- **Parallel Route.** This alternative element constructs a new two-lane multipurpose roadway north of Idaho Springs between Fall River Road and the Hidden Valley interchange. This road serves to provide additional capacity parallel to the I-70 highway in this area.
- **Silverthorne Tunnel.** This alternative element provides a tunnel for the I-70 highway from just east of Silverthorne to just west of the Empire Junction interchange. This tunnel is 25 miles in length and runs below the Eisenhower-Johnson Memorial Tunnels at an elevation of around 8,500 to 8,800 feet, approximately 4,000 to 4,500 feet below the elevation of the Continental Divide. It is a three lane highway tunnel with a second bore for emergency access.

4.6.3 Level 1 Screening

Level 1 screening focused on identifying the areas of the Corridor that warranted consideration of highway capacity improvements. Level 1 screening identifies areas with existing mobility, safety and maintenance concerns. These areas were termed problematic areas. The evaluation criteria for determining the problematic areas included performance measures for congestion and safety. Alternative elements were then evaluated to determine if they addressed the issues identified in the problematic areas.

The problematic areas were identified by a composite of congestion and safety concerns. Congestion is measured by the ratio of the volume of traffic over the roadway capacity; this measurement establishes the level of service condition of the roadway. Level of Service F indicates congestion, delays, and stop-and-go conditions. The threshold of 365 annual hours of Level of Service F congestion in either direction determines the congestion problematic areas. Current congestion corresponds to just over 6 hours of congestion a day occurring on 40 to 60 peak days over the course of the year.

The incidence of crashes along the I-70 highway is another defining indicator of problematic areas. Areas where the crash rate is higher than the average for mountainous roads are considered problematic. The crash rate is calculated using the weighted hazard index.

The composite problematic area is determined by areas meeting any one of the following characteristics: poor Level of Service, sharp curves or “S” curves, safety concerns, lane drops, traffic bottlenecks, tunnels, high crash areas, steep grades, high rock fall incident areas, and/or areas prone to extreme ice or snow build-up. Based on the analysis, the resulting problematic areas are the Dowd Canyon area between Eagle-Vail and West Vail, and the 33-mile segment between the west portal of the Eisenhower-Johnson Memorial Tunnels and Floyd Hill. (See **Figure 3** for a summary of these areas.)

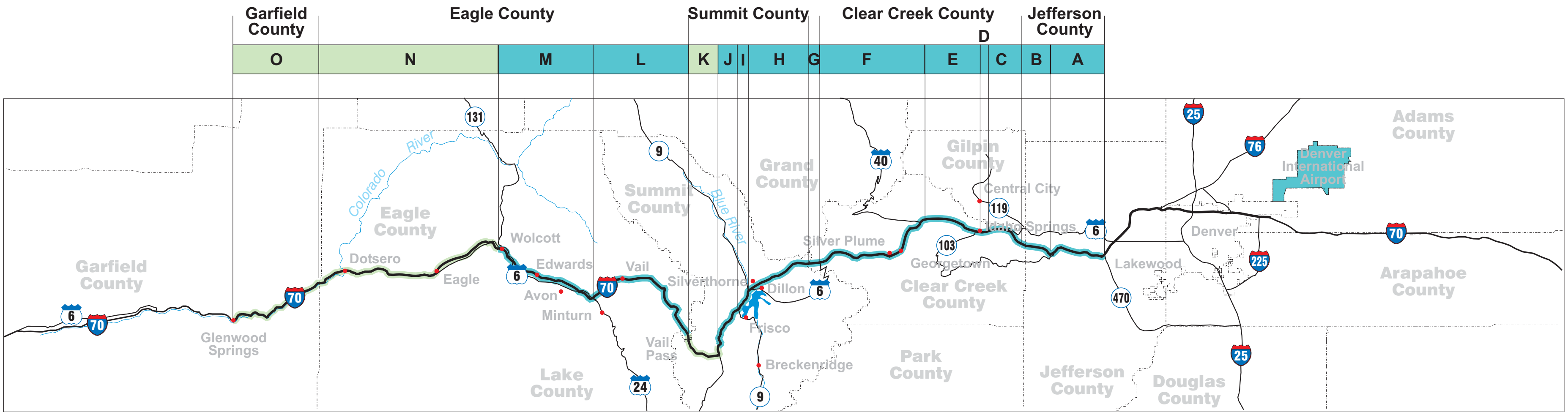
In other areas of the Corridor, all highway widening alternative elements were eliminated from further consideration, because the threshold was not met for congestion or safety. However, many of these locations include Localized Highway Improvements to address other Corridor concerns. Specifically, highway widening alternative elements were eliminated in the following locations:

- Glenwood Springs (milepost 116) to Eagle-Vail (milepost 169);
- West Vail (milepost 173) to Eisenhower-Johnson Memorial Tunnels (milepost 214); and
- Floyd Hill (milepost 247) to C-470 (milepost 260). In this location, as in others, other alternative elements evaluated included Localized Highway Improvements (interchange improvements, curve safety modifications and auxiliary lanes) and transit improvements. Improvements such as reversible lanes or movable median were not considered because of the constraints of the split profile of the I-70 highway through Mount Vernon Canyon.

All six Highway alternative elements were advanced to Level 2 screening because they make improvements in the problematic areas of the I-70 Mountain Corridor within Dowd Canyon (between Eagle-Vail and West Vail) and from Eisenhower-Johnson Memorial Tunnels to Floyd Hill.

Figure 3. Summary of Problematic Highway Areas

H	G	F	E	D	C	B	A
Eisenhower Tunnel to SH 9 at Silverthorne MP 213 to MP 205.5	Eisenhower Tunnel MP 217 to MP 213	US 40 to Eisenhower Tunnel MP 232.5 to MP 217	Twin Tunnels to US 40 MP 241.5 to MP 232.5	Twin Tunnels MP 242.5 - 241.5	Floyd Hill to Twin Tunnels MP 246.5 to MP 242.5	Evergreen Exit to Floyd Hill MP 251 to MP 246.5	C470 to Evergreen Exit MP 260 to MP 251
Roadway Characteristics and Traffic Operations • Grades greater than 6% (MP 207.5 - MP 213) • Slow moving truck traffic eastbound • High accident rate at Exit 205 and MP 210 Summer EB: D Summer WB: C Winter EB: D Winter WB: C	**Roadway Characteristics and Traffic Operations** • Narrow shoulders • Limited capacity • Represents regional bottleneck in I-70 Mountain Corridor • Lane Drop - 6 lanes to 4 lanes at MP 213.25 • Lane reduction eastbound leaving Eisenhower Tunnel (accident rate high) Summer EB: E Summer WB: E Winter EB: E Winter WB: E	**Roadway Characteristics and Traffic Operations** • Grades greater than 6% (Georgetown & MP 215 - 216.5) • Limited capacity • Rock fall area • Inside shoulder • Curves near Silver Plume MP 227, 224 • Silver Plume interchange • Lane reduction eastbound leaving Eisenhower Tunnel at the merge of US 6 (accident rate high) • High accident rate density at base of hill Summer EB: E Summer WB: D Winter EB: E Winter WB: E	**Roadway Characteristics and Traffic Operations** • Multiple interchanges in short distance • Tight horizontal curves - Fall River Road • Design Speed • Heavy eastbound merge at Empire/ US 40 Summer EB: F Summer WB: D-E Winter EB: F Winter WB: E-F	**Roadway Characteristics and Traffic Operations** • Limited capacity • Posted speed - 50 mph • High accident rate • Lateral clearances 1ft. in Twin Tunnels Summer EB: F Summer WB: E Winter EB: F Winter WB: F	**Roadway Characteristics and Traffic Operations** • Grades greater than 6% on Floyd Hill • Lane reduction at westbound MP 246 and at "S" curves MP 244.5 to 242.5 • Design speed - 50-55 mph at SH 6 • Left-side merge at SH 6 • Short decel lanes at SH 6 • Accident area MP 244-242.5 Summer EB: D-F Summer WB: D-F Winter EB: D-F Winter WB: D-F	**Roadway Characteristics and Traffic Operations** • Grades vary from 1% to 6% (Floyd Hill) Summer EB: D Summer WB: D Winter EB: D Winter WB: E	**Roadway Characteristics and Traffic Operations** • Grades vary from 3% to 6.5% • Heavy merge eastbound at Evergreen Exit 251 • High accident rate at C470 and Morrison Exits (260 and 258.5) • Six lanes Summer EB: D-E Summer WB: D-F Winter EB: E Winter WB: C-F
Year 2000 Problematic Areas MP 210, 206 - 205.5	Year 2000 Problematic Areas MP 217 - 213	Year 2000 Problematic Areas MP 228 - 226	Year 2000 Problematic Areas MP 242 - 232.5	Year 2000 Problematic Areas MP 241.5 - 242.5	Year 2000 Problematic Areas MP 245 - 242	Year 2000 Problematic Areas MP 248 - 246.5	Year 2000 Problematic Areas MP 260 - 251



O	N	M	L	K	J	I
Eagle County to Glenwood Springs MP 130.5 to Glenwood Springs	Wolcott to Eagle County Line MP 156.5 to MP 130.5	US 24/Minturn to Wolcott MP 171 to MP 156.5	Vail Pass to Minturn (US 24) MP 189 to MP 171	Copper Mountain to Vail Pass MP 195.5 to MP 189	Frisco to Copper Mountain MP 202.5 to MP 195.5	Silverthorne to Frisco MP 205.5 to MP 202.5
Roadway Characteristics and Traffic Operations Glenwood Canyon	**Roadway Characteristics and Traffic Operations** • Grades rarely exceed 3% • High accident rate at Eagle interchange (MP 146.5) Summer EB: B Summer WB: D Winter EB: A Winter WB: B	**Roadway Characteristics and Traffic Operations** • Grades less than 3% • Weekday winter commuter traffic is comparable to weekend traffic on I-70 • High incidence of accidents MP 160.5 - 166.5 Summer EB: C Summer WB: D Winter EB: B Winter WB: B	**Roadway Characteristics and Traffic Operations** • Grades greater than 5% (MP 177.5 - 181) • Slow moving traffic on long grades • Heavy merging along Vail exits 180, 176, and 173 • Highest accident rate of study area at Minturn/US 24 Exit 171 • Potential weather concerns (ice build-up on Vail Pass and near Dowd Canyon) • US 24/Minturn interchange configuration • Summer and winter weekend traffic is predominant; however, weekday commuter traffic is becoming noticeable Summer EB: D Summer WB: C Winter EB: C Winter WB: B	**Roadway Characteristics and Traffic Operations** • Grades greater than 5% • Slow moving traffic on long grades Summer EB: D Summer WB: C Winter EB: C Winter WB: B	**Roadway Characteristics and Traffic Operations** • Grades of 5% and 6% • High accident rate at Frisco interchange (MP 202.5) Summer EB: D Summer WB: D Winter EB: D Winter WB: D	**Roadway Characteristics and Traffic Operations** • Heavy merges at Silverthorne and Frisco exits (205 and 203) • Grades greater than 5% (MP 204 - 205) • Weekend summer and winter traffic is predominant; however, weekday commuter traffic is becoming noticeable Summer EB: D Summer WB: D Winter EB: D Winter WB: C
Year 2000 Problematic Areas	Year 2000 Problematic Areas	Year 2000 Problematic Areas MP 171 - 170, 166.5 - 160.5	Year 2000 Problematic Areas MP172 - 171	Year 2000 Problematic Areas	Year 2000 Problematic Areas MP 202.5, 200 - 198	Year 2000 Problematic Areas MP 205, 202.5

LEGEND

EB=eastbound
WB=westbound
LOS=Level of Service (LOS ratings vary from most desirable (LOS A) to forced break-down (LOS F))
(LOS calculated at mileposts with steep grades, lane changes or large traffic volumes)

A=free-flow operations
B=reasonably free-flow operations
C=noticeable traffic
D=speeds decline and congestion
E=maximum service flow (full capacity)
F=heavy congestion, significant delays, stop-and-go traffic

LOS:
Under Current Traffic Volumes

Problematic Areas Identified within Section for Year 2000: Areas would include at least one or a combination of the following conditions: LOS F, sharp curves or "S" curves, safety concerns at interchanges, lane drops, traffic bottlenecks, tunnels, high accident areas, steep grades, high rock fall incident areas, and areas prone to extreme ice and snow build-up

Not Considered Problematic Under Existing Conditions (Year 2000)

4.6.4 Level 2 Screening

Level 2 evaluation criteria included performance measures reflecting purpose and need, safety and maintenance concerns, and environmental sensitivity and community values. These criteria were used to evaluate improvements in the two problematic areas within Dowd Canyon (between Eagle-Vail and West Vail) and from Eisenhower-Johnson Memorial Tunnels to Floyd Hill:

- **Capacity:** Volume/capacity (V/C) ratio between proposed 2035 traffic volume and proposed highway capacity.
- **Mobility:** Calculated free-flow speed from VISSIM model.
- **Congestion:** Duration of congested hours.
- **Safety:** Safety improvements measured by reduction in crashes and ability to address roadway deficiencies.
- **Implementation:** Screening criteria for cost and constructability coupled with engineering judgment to provide an initial determination of how each element fared in its reasonableness and practicality.
- **Environmental sensitivity:** Potential for conflict with geologic hazards, water quality, wildlife, fishery resources, wildlife habitat and crossings, and threatened, endangered, and special status species.
- **Community values:** Potential for conflict with land use, recreation, historic resources, noise, and federal management scenic features and views.

The Level 2 screening used these criteria for a comparative analysis of the alternative elements by location within the problematic areas. The elimination of alternative elements in Level 2 screening focused on mobility, safety, and implementation. The following highway alternative elements in the Dowd Junction problematic area (mileposts 169 to 173) and in the problematic area between Eisenhower-Johnson Memorial Tunnels and Floyd Hill (mileposts 214 to 247) were eliminated in Level 2 screening. Note that these alternative elements apply only to these two problematic areas but may be used in other locations in the Corridor, where appropriate.

- **Limited Six-Lane Highway Widening.** In Level 2, alternative elements that addressed only the segment between Empire Junction and Floyd Hill were eliminated from further analysis because they addressed congestion in only a small segment of the Corridor and did not meet the underlying need of the project, because congestion was relieved for only 3 of the 12 problematic areas in the Corridor.
- **Flex Lanes.** Flex lanes were eliminated due to poor safety as a result of inconsistent lane balance for sections of highway on either side of the flex lane section. In addition, a four-foot shoulder width does not meet AASHTO design standards and is incompatible with CDOT's Incident Management Plan, requiring sufficient shoulder width to operate emergency vehicles. A four-foot-wide shoulder does not allow broken-down vehicles to get out of the flow of traffic. In the safety performance criteria of crash reduction potential, this alternative element is in the lowest comparable category with a reduction of crashes of zero percent to nine percent.
- **Parallel Route.** A new two-lane multipurpose roadway north of Idaho Springs between Fall River Road and the Hidden Valley interchange was eliminated because it did not meet the criterion of reducing congestion. To reduce congestion on the I-70 highway, it needs to serve as an "alternate route." This parallel route removes traffic for a few miles only, so is not able to reduce congestion corridor-wide and thus does not meet an "alternate route" function. In addition, there are severe constructability issues north of Idaho Springs. This area is very mountainous and steep and topographically incompatible for a highway alignment proceeding west to the Fall River area.

- **Silverthorne Tunnel.** The tunnel proposed between Silverthorne and Empire Junction is eliminated because of major constructability challenges, and lack of local access. At a proposed length of 25 miles, this tunnel is longer than any tunnel ever constructed. The closest comparison is the Laerdal Tunnel in Norway, which is just over 15 miles long. There is no precedent for a tunneling method for this kind of tunnel. A major challenge is the potential for a tunnel fire and resulting carbon monoxide pollution. Major unknowns associated with the geological conditions approximately a mile below the Continental Divide present additional challenges. Geologic conditions associated with constructing through the Continental Divide include squeezing rock, potential for tunnel collapse and floor heave. These problems add substantial time and cost to construction of a tunnel. In addition, it does not provide direct access to the local communities of Georgetown, Silver Plume, and Bakerville. For these reasons, this alternative element was eliminated.

The following highway alternative elements were advanced to Level 3 screening:

- Six-Lane Highway Widening
- Horizontal Widening – Standard Shoulders
- Horizontal Widening – Variable Shoulders
- Horizontal Widening – Smart Widening
- Vertical Widening – Structured
- Vertical Widening – Cantilevered Lanes
- Vertical Widening – Tunneled Lanes
- Reversible/HOV/HOT Lanes
- Movable Median

4.6.5 Level 3 Screening

Level 3 evaluation criteria is the same as Level 2 and included performance measures reflecting purpose and need, safety and maintenance concerns, environmental sensitivity and community values. Accessibility was an additional criteria considered in Level 3. These criteria were used for comparative analysis purposes.

- **Capacity –**Volume/capacity (V/C) ratio between 2035 traffic volume and highway capacity under each of the alternatives
- **Mobility –** Calculated free-flow speed from VISSIM model
- **Congestion –** Duration of congested hours
- **Safety –** Safety improvements measured by reduction in crashes and ability to address roadway deficiencies
- **Implementation –** Screening criteria for cost and constructability coupled with engineering judgment to provide an initial determination of how each element fared in its reasonableness and practicality
- **Environmental sensitivity –** Potential for conflict with geologic hazards, water quality, wildlife, fishery resources, wildlife habitat and crossings, and threatened, endangered, and special status species
- **Community values –** Potential for conflict with land use, recreation, historic resources, noise, and federal management scenic features and views
- **Accessibility –** Potential for impact on local traffic movements

The elimination of alternative elements in Level 3 focused on mobility, implementation, environmental sensitivity, and community values. The following highway alternative elements in the Dowd Junction problematic area (mileposts 169 to 173) and in the problematic area between Eisenhower-Johnson Memorial Tunnels and Floyd Hill (mileposts 214 to 247) were eliminated in Level 3 screening:

- **Six-Lane Highway Widening—Select Horizontal Widening.** Horizontal Widening with standard shoulders, variable-width shoulders, or smart widening was eliminated in the Idaho Springs area (milepost 239 to milepost 241) due to unacceptable impacts on the environment and community values. In the Idaho Springs area, the Corridor is confined by a narrow canyon and very close proximity to Clear Creek on the south side and the developed area of Idaho Springs on the north. Six-lane Horizontal Widening in this area results in unacceptable impacts on Clear Creek, historic and parks properties, many of which are protected by Section 4(f) of the United States Department of Transportation Act of 1966, as amended, fish habitat, geological hazards and water quality.

  In other portions of the problematic areas, Six-Lane Horizontal Widening was advanced for analysis in the PEIS with six-lane variable shoulders as representative.
- **Movable Median**. This alternative element was eliminated because it did not meet the purpose and need criteria of reducing congestion and improving mobility. The required 1.5 hours of time (at an approximate speed of 10 miles per hour) to switch the barrier at mid-day combined with total traffic volume moving through this area results in insufficient capacity to meet the 2035 demand.

Among the remaining highway alternative elements, some were advanced for further evaluation in the PEIS, and some were retained for consideration in Tier 2 processes as described below:

Six-Lane Highway Widening:

- **Horizontal Widening–Standard Shoulders.** In the problematic areas, but excluding Idaho Springs (milepost 239 to 241), this alternative element was retained for consideration in Tier 2 but was not advanced for evaluation in the PEIS because it moves a similar amount of people but with greater environmental impacts compared to Horizontal Widening with Variable Shoulders. Narrow canyons and the existing highway's close proximity to Clear Creek results in greater impacts to environmental resources with the standard shoulders. This alternative element has the greatest potential for unavoidable impacts to water quality, fish habitat, geologic hazards, threatened, endangered, and special status species, historic resources, and community values and was not advanced as representative of highway widening for analysis in the PEIS. Horizontal Widening was eliminated as an alternative element in the Idaho Springs area (milepost 239 to milepost 241) due to Clear Creek, historic and park properties.
- **Horizontal Widening–Variable Shoulders.** In the problematic areas, but excluding Idaho Springs (milepost 239 to 241), this alternative element is advanced for evaluation in the PEIS as representative of Horizontal Highway Widening because it moves a similar amount of people but with fewer environmental impacts compared to Horizontal Widening with Standard Shoulders. Horizontal Widening is eliminated as an alternative element in the Idaho Springs area (milepost 239 to milepost 241) due to unacceptable impacts on Clear Creek, historic and park properties.

In Level 3, two design speeds for highway widening with variable shoulders were further delineated:

- 55 mile per hour
- 65 mile per hour
- **Horizontal Widening – Smart Widening.** This alternative element was retained for consideration in Tier 2, but not advanced for evaluation in the PEIS. While not eliminated, this alternative element has safety concerns associated with the reduced shoulder, median and clear zone widths, and non-conformity with safety standards.

- **Vertical Widening–Structured/Cantilevered Lanes.** In the area of Idaho Springs (milepost 239 to 241), this alternative element was advanced for evaluation in the PEIS as representative of Vertical Highway Widening because it moves a similar amount of people with fewer environmental impacts compared to Vertical Widening with Tunneled Lanes.
- **Vertical Widening–Tunneled Lanes.** In the area of Idaho Springs (milepost 239 to 241), this alternative element was retained for consideration in Tier 2 processes, but not further evaluated in the PEIS due to greater environmental impacts compared to Vertical Widening with Structured Lanes. This type of construction is anticipated to experience technical difficulty due to its proximity to Clear Creek and presence of mine tailings.
- **Reversible/HOV/HOT Lanes.** The Reversible/HOV/HOT lane alternative element was advanced for analysis in the PEIS.

4.6.6 Highway Alternative Elements Advanced for Evaluation in PEIS

The six-lane highway alternative elements advanced for evaluation in the PEIS are summarized below. These represent a reasonable range of highway alternatives that can be considered at Tier 2.

- **Six-Lane Highway Widening 55 mph with a variable shoulder width (8-foot to 10-foot shoulders)** at Dowd Canyon and from Eisenhower-Johnson Memorial Tunnels to Floyd Hill. An additional tunnel bore is required at the Eisenhower-Johnson Memorial Tunnels and Twin Tunnels, and structured lanes are used through Idaho Springs. Two design speeds are included to (1) establish corridor consistency and (2) address deficient areas within the Corridor. The 55 mph design speed establishes a consistent design speed throughout the Corridor, which currently does not exist.
- **Six-Lane Highway Widening 65 mph with variable shoulder width (8-foot to 10-foot shoulders)** at Dowd Canyon and from Eisenhower-Johnson Memorial Tunnels to Floyd Hill. Similar to the 55 mph alternative element, the 65 mph design speed further improves mobility and addresses safety deficiencies in key locations such as Dowd Canyon and the Twin Tunnels, but requires two new tunnel bores at Dowd Canyon, a new westbound tunnel bore from Hidden Valley to Twin Tunnels, a new eastbound tunnel bore from Hidden Valley to Floyd Hill, and structured lanes are used through Idaho Springs.
- **Reversible/HOV/HOT Lanes—**includes Reversible/HOV/HOT lanes from the west portal of the Eisenhower-Johnson Memorial Tunnels to Floyd Hill and six-lane widening (not reversible) at Dowd Canyon.

The results of the screening process for the Highway Improvement Alternative Elements are summarized in **Table 8**.

Table 8. Highway Improvement Alternative Elements

Highway Improvement Alternative Element	Screened – Level 1 Screening	Screened – Level 2 Screening	Screened – Level 3 Screening	Advanced for Action Alternative Development
Eagle-Vail to Vail West (milepost 169–milepost 173)				
Six-Lane Highway – I-70 Highway Alignment				✓
Silverthorne to Empire Junction (milepost 205-milepost232)				
Six-Lane Highway – I-70 Highway Alignment				✓
Eisenhower Johnson Memorial Tunnel to Silver Plume (milepost 215.5–milepost 226)				
Six-Lane Horizontal Widening – Variable Shoulder (8 feet to 10 feet) as representative				✓
Reversible/HOV/HOT Lanes				✓
Flex Lanes		X		
Silver Plume to Georgetown (milepost 226–milepost 228)				
Six-Lane Horizontal Widening – Variable Shoulder (8 feet to 10 feet) as representative				✓
Reversible/HOV/HOT Lanes				✓
Flex Lanes		X		
Georgetown to Empire Junction (milepost 228–milepost 232)				
Six-Lane Horizontal Widening – Variable Shoulder (8 feet to 10 feet) as representative				✓
Reversible/HOV/HOT Lanes				✓
Flex Lanes		X		
Empire Junction to West Idaho Springs (milepost 232–milepost 239)				
Six-Lane Horizontal Widening – Variable Shoulder (8 feet to 10 feet) as representative				✓
Movable Median			X	
Reversible/HOV/HOT Lanes				✓
Flex Lanes		X		
West Idaho Springs to East Idaho Springs (milepost 239–milepost 241)				
Structured Lanes as representative				✓
Movable Median			X	
Reversible/HOV/HOT Lanes				✓
Flex Lanes		X		
Parallel Routes		X		
East Idaho Springs to Twin Tunnels (milepost 241–milepost 242)				
Six-Lane Horizontal Widening – Variable Shoulder (8 feet to 10 feet) as representative				✓
Movable Median			X	
Reversible/HOV/HOT Lanes				✓
Flex Lanes		X		

Table 8. Highway Improvement Alternative Elements

Highway Improvement Alternative Element	Screened – Level 1 Screening	Screened – Level 2 Screening	Screened – Level 3 Screening	Advanced for Action Alternative Development
Parallel Routes		X		
Twin Tunnels to US 6 (milepost 242–milepost 244)				
Six-Lane Horizontal Widening – Variable Shoulder (8 feet to 10 feet) as representative				✓
Movable Median			X	
Reversible/HOV/HOT Lanes				✓
Flex Lanes		X		
Parallel Routes		X		
US 6 to Floyd Hill (milepost 244–milepost 247)				
Six-Lane Horizontal Widening – Variable Shoulder (8 feet to 10 feet as representative				✓
Movable Median			X	
Reversible/HOV/HOT Lanes				✓
Flex Lanes		X		

Key to Abbreviations/Acronyms:
EB = eastbound   HOT = High Occupancy Toll   HOV = High Occupancy Vehicle
mph = miles per hour   WB = westbound

4.7 Alternate Routes

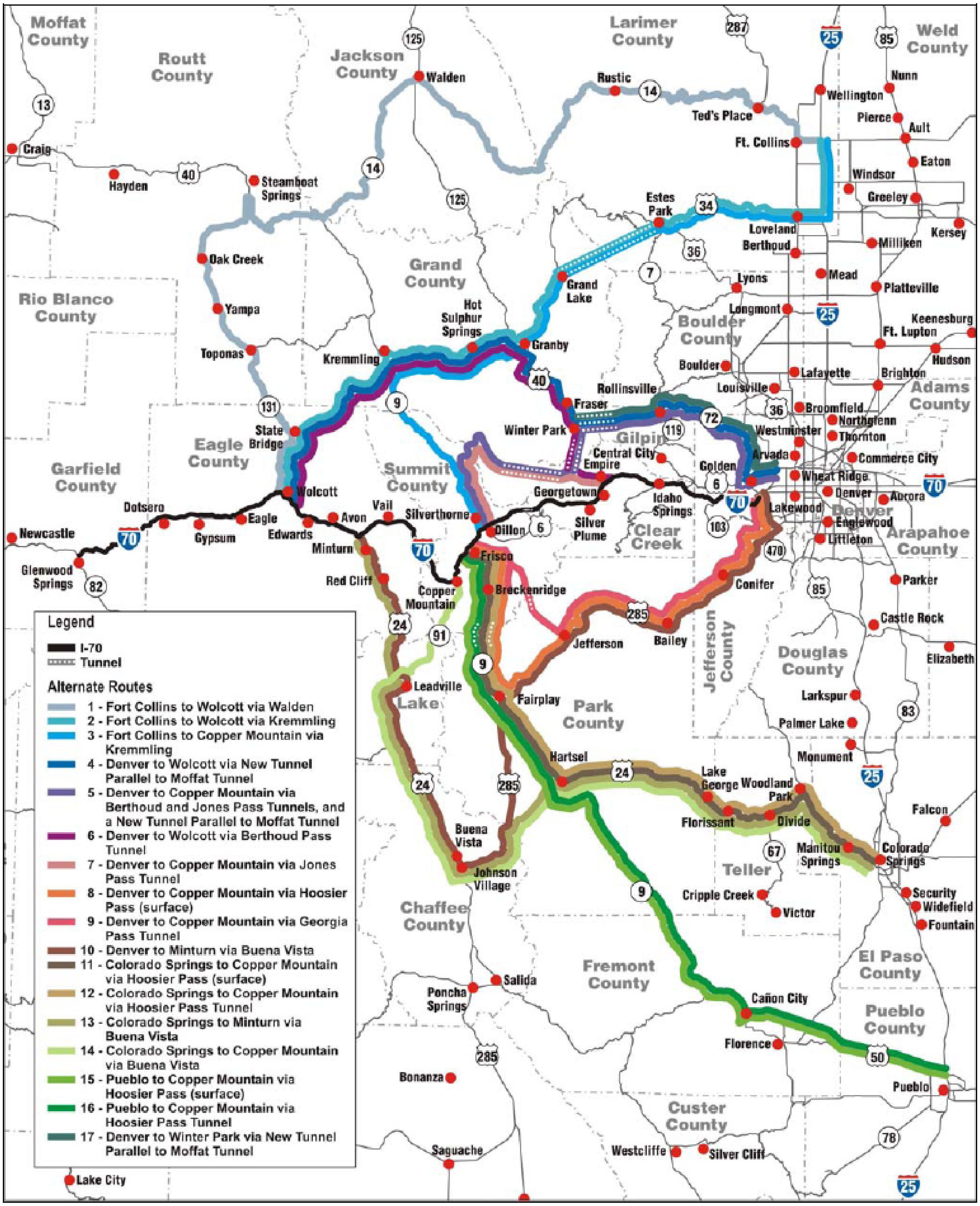
4.7.1 Introduction

Alternate Routes were identified to determine if there was a reasonable option available to travel on the I-70 highway eliminating the need for major improvements to the I-70 highway. These potential Alternate Routes involved improving existing state highways and building new connections (often tunnels) to shorten distances and travel times. The mountainous terrain encountered west of Fort Collins, Denver, Colorado Springs and Pueblo severely limits the range of these Alternate Routes.

4.7.2 Alternate Routes Evaluated

Seventeen Alternate Routes were identified with eastern termini ranging from Fort Collins to Pueblo and western termini at various points along the I-70 highway west of the Continental Divide as far west as Wolcott in Eagle County. (See **Figure 4** for locations of each of the Alternate Routes.) These Alternate Routes connect the central Rocky Mountains with the four principal cities (Fort Collins, Denver, Colorado Springs and Pueblo) along the Front Range.

Figure 4. Alternate Routes Considered in Screening Process



Three Alternate Routes connect with Fort Collins, seven with Denver and Denver International Airport, four with Colorado Springs, two with Pueblo, and one between Golden and Winter Park. More detail about each of these is contained in **Appendix I** *I-70 Mountain Corridor PEIS Alternate Routes Technical Report*.

- **Fort Collins to Wolcott via Walden (SH 14 and SH 131).** This Alternate Route uses existing state highways along its entire length. Widening of some state highways is assumed. This route is 225 miles long.
- **Fort Collins to Wolcott via Kremmling (US 34).** This Alternate Route uses two new road segments to connect existing state highways. A long tunnel of 12.2 miles is assumed under Rocky Mountain National Park from Estes Park to Grand Lake and a new two-lane roadway is built between Kremmling and State Bridge. This route is 140 miles long.
- **Fort Collins to Copper Mountain via Kremmling (US 34 and SH 9).** This Alternate Route is identical to Route 2 between Fort Collins and Kremmling. SH 9 south of Kremmling is upgraded from two to three lanes. This Route is 149 miles long.
- **Denver to Wolcott via Moffat Tunnel (SH 72, US 40, and US 34).** This Alternate Route uses eight state highways, a new tunnel and a new route between Kremmling and State Bridge. This route is 142 miles long.
- **Denver to Copper Mountain via Moffat, Berthoud, and Jones Pass Tunnels (SH 72 and SH 9).** This Alternate Route includes construction of three new tunnels. This route is 116 miles long.
- **Denver to Wolcott via Berthoud Pass Tunnel (US 40 and US 34).** This Alternate Route includes a new road from Kremmling to State Bridge and a new tunnel under Berthoud Pass. This route is 142 miles long.
- **Denver to Copper Mountain via Jones Pass Tunnel (SH 9).** This Alternate Route includes a new tunnel under Jones Pass, a new road from Berthoud Falls to SH 9 and widening of SH 9. This route is 99 miles long.
- **Denver to Copper Mountain via Hoosier Pass (surface) (US 285 and SH 9).** This Alternate Route uses existing state highways and assumes widening of those. This route is 125 miles long.
- **Denver to Copper Mountain via Georgia Pass Tunnel (US 285).** This Alternate Route assumes a new road along Michigan Creek and Swan River with a tunnel under Georgia Pass and widening of US 285 and SH 9. This route is 105 miles long.
- **Denver to Minturn via Buena Vista (US 285 and US 24).** This Alternate Route uses existing highways to connect Denver with Minturn. This route is 192 miles long.
- **Colorado Springs to Copper Mountain via Hoosier Pass (surface) (US 24 and SH 9).** This Alternate Route upgrades two existing highways to connect Colorado Springs with Summit County. This route is 118 miles long.
- **Colorado Springs to Copper Mountain via Hoosier Pass Tunnel (US 24 and SH 9).** This Alternate Route is similar to Route 12 except that it includes a tunnel under Hoosier Pass. This route is 114 miles long.
- **Colorado Springs to Minturn via Buena Vista (US 24).** This Alternate Route improves US 24 between Colorado Springs and Minturn. This route is 161 miles long.
- **Colorado Springs to Copper Mountain via Buena Vista (US 24 and SH 91).** This Alternate Route uses a longer section of US 24 (than Route 13) to connect differently to Summit County. This route is 152 miles long.
- **Pueblo to Copper Mountain via Hoosier Pass (surface) (US 50 and SH 9).** This Alternate Route follows US 50 from Pueblo to SH 9 and upgrades SH 9 over Hoosier Pass. This route is 147 miles long.
- **Pueblo to Copper Mountain via Hoosier Pass Tunnel (US 50 and SH 9).** This Alternate Route follows US 50 west from Pueblo to SH 9 and includes a tunnel under Hoosier Pass. This route is 143 miles long.
- **Golden to Winter Park via a new tunnel parallel to Moffat Tunnel (SH 58, SH 93, and SH 72).** This Alternate Route includes a new tunnel parallel to the Moffat Tunnel, a new road

from Rollinsville to Winter Park, a new road from Kremmling to State Bridge and widening of other state highways. This route is 142 miles long.

4.7.3 Level 1 Screening

Evaluation of the seventeen Alternate Routes at Level 1 screening focused on criteria related to project purpose and need, including:

- **Mobility –** Ability to provide a competitive travel time advantage compared to I-70 highway travel
- **Accessibility –** Proximity to current origins and destinations along the I-70 Corridor
- Travel market served **–** Proximity to Denver Front Range communities, where the majority of I-70 highway travel originates

All of these criteria were used to determine the potential of these seventeen Alternate Routes to alleviate traffic on the I-70 highway, eliminating the need for mobility improvements to the I-70 highway.

Seven of the Alternate Routes result in travel times noticeably longer than times experienced by I-70 travelers, based on the distance and the average posted speeds. These Alternate Routes, and the comparative travel times, are shown on **Table 9**. For these reasons, as well as their inability to provide sufficient accessibility to I-70 Corridor communities because of their location miles away from these communities, these Alternate Routes were eliminated at Level 1.

Alternate Routes that were eliminated are:

- AR–1 (SH 14 via Walden)
- AR–4 (SH 72 via Moffat Tunnel)
- AR–5 (SH 72 via Moffat, Berthoud Pass and Jones Pass Tunnels)
- AR–6 (I-70 to US 40 via Berthoud Pass Tunnel)
- AR–7 (US 40 via Jones Pass Tunnel)
- AR–8 (US 285 via Hoosier Pass)
- AR–10 (US 285 via Buena Vista)

Table 9. Alternate Routes with Comparative Distances and Travel Times

Origin	Destination	Route	Distance (miles)	Travel Time (Minutes)	Congested Travel Time (Minutes)
Fort Collins	Wolcott	I-70	173	154	206
		AR-1—SH 14 via Walden	225	267	323
		AR-2—US 34 via Kremmling	140	172	211
Fort Collins	Copper Mountain	I-70	135	119	171
		AR-3—US 34 via Kremmling	149	178	218
Denver	Wolcott	I-70	117	109	165
		AR-4—SH 72 via Moffat Tunnel	142	197	244
		AR-6—I-70 to US 40 via Berthoud Pass Tunnel	142	162	211
Denver	Copper Mountain	I-70	79	74	130
		AR-5— SH 72 via Moffat, Berthoud Pass and Jones Pass Tunnels	116	169	230
		AR-7—US 40 via Jones Pass Tunnel	99	113	154

Table 9. Alternate Routes with Comparative Distances and Travel Times

Origin	Destination	Route	Distance (miles)	Travel Time (Minutes)	Congested Travel Time (Minutes)
		AR-8—US 285 via Hoosier Pass	125	147	185
		AR-9— US 285 via Georgia Pass	105	118	130
Denver	Minturn	I-70	103	97	152
		AR-10— US 285 via Buena Vista	192	231	268
Colo. Springs	Copper Mountain	I-70	144	131	184
		AR-11— US 24 via Hoosier Pass	118	138	182
		AR-12— US 24 via Hoosier Pass Tunnel	114	129	166
		AR-13— US 24 via Buena Vista	152	171	215
Colo. Springs	Minturn	I-70	168	153	206
		AR-14— US 24 via Buena Vista	161	194	244
Pueblo	Copper Mountain	I-70	186	170	223
		AR-15— US 50 via Hoosier Pass (surface)	147	158	196
		AR-16— US 50 via Hoosier Pass (tunnel)	143	149	180
Denver	Winter Park	I-70		109	165
		AR-17— SH 72 via new tunnel parallel to Moffat Tunnel	142	197	244

Key to Abbreviations/Acronyms

AR = alternate route

Additional Level 1 screening included the travel market served, defined as the location that is the assumed origin of travelers using the I-70 highway. **Table 10** illustrates I-70 User Data from CDOT from the counties of residence in Colorado. Data from the *I-70 User Study, Denver to Vail, Colorado, Summer 1999 and Winter 2000 Surveys* (HNTB, July 2000) shown in **Table 10** (and illustrated spatially on **Figure 5**) demonstrate that the majority of travelers on the I-70 highway either reside in the Denver Front Range Area, within the Corridor counties, or are from out of state.

These data were used to screen the eight Alternate Routes that originate from Pueblo, Colorado Springs or Fort Collins. Travelers originating from the South Front Range Counties (including Pueblo and Colorado Springs) and North Front Range Counties (including Fort Collins) average only 3.6 percent (from the South Front Range) or 3.5 percent (from the North Front Range) of total traffic on the I-70 highway. Travel that originates from the Denver Front Range Counties, the Corridor Counties or from out of state origins averages substantially more than that. These data support conclusions that the eight Alternate Routes originating from the South Front Range or the North Front Range do not have the potential to divert more than 3 to 4 percent of the travel on the I-70 highway and do not meet the purpose and need for improving mobility along the I-70 highway. Additional mobility improvements are needed to reduce congestion and improve mobility along the Corridor.

Results from this screening were used to eliminate the following eight Alternate Routes:

- AR-2 (US 34 via Kremmling)
- AR-3 (US 34 via Kremmling)
- AR-11 (US 24 via Hoosier Pass)
- AR-12 (US 24 via Hoosier Pass Tunnel)
- AR-13 (US 24 via Buena Vista)
- AR-14 (US 24 via Buena Vista)
- AR-15 (US 50 via Hoosier Pass)
- AR-16 (US 50 via Hoosier Pass Tunnel)

To summarize, 15 of the 17 Alternate Routes evaluated were eliminated in Level 1.

Figure 5. Percentage of Vehicles in I-70 Corridor

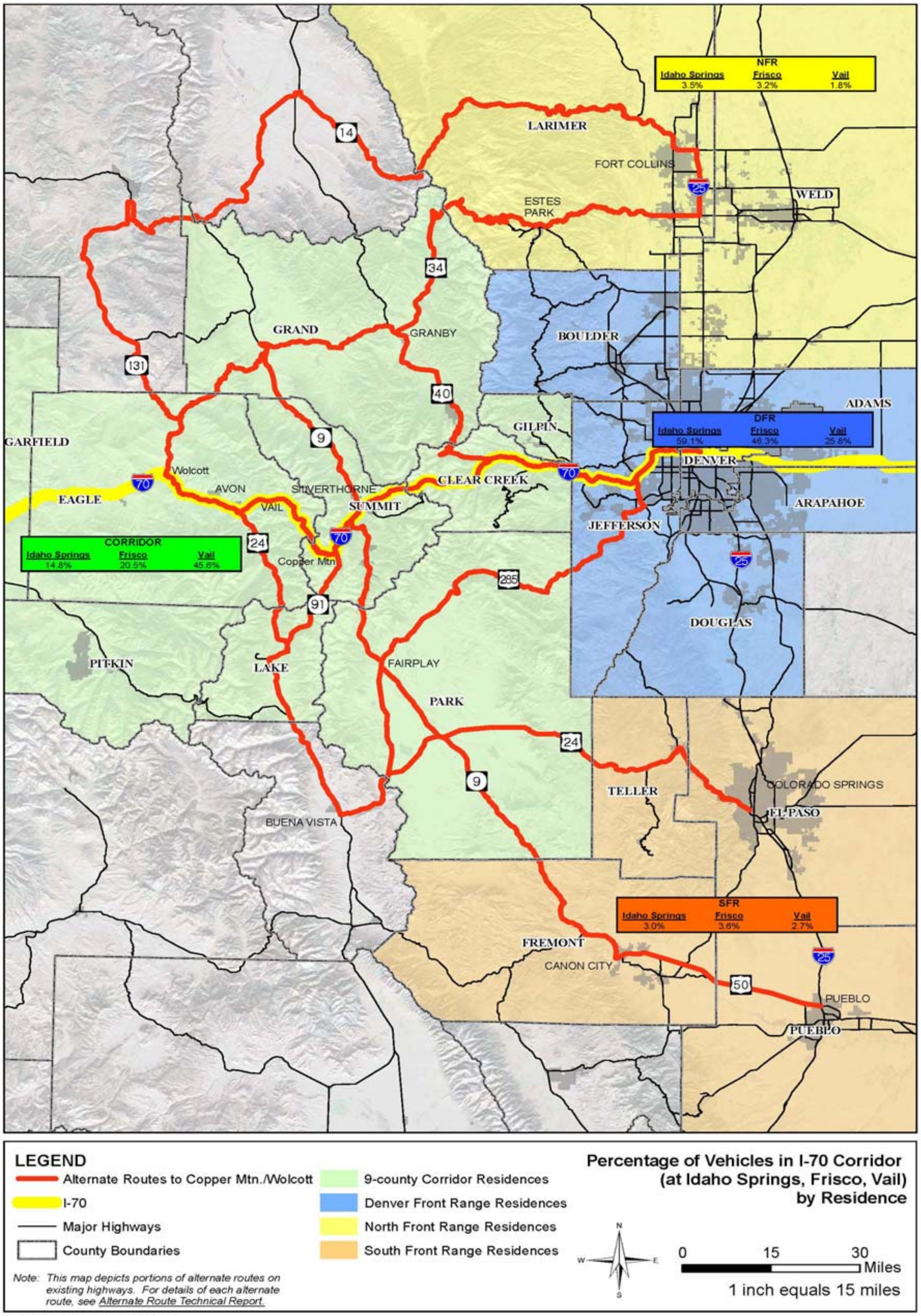


Table 10. Percentage Vehicles by County of Residences.

	Summer 1999 Survey			Winter 2000 Survey		
	Denver Front Range Counties					
Counties	Idaho Springs	Frisco	Vail	Idaho Springs	Frisco	Vail
Adams	4.7	3.3	2.1	3.6	2.3	1
Arapahoe	10.8	7.9	5.4	9.6	7.9	3.6
Boulder	6	5.3	3.1	6.8	5.4	2.4
Denver	19.8	15.8	12.2	20.7	20.6	10.9
Douglas	4.7	3	1.7	4	3.1	1.2
Jefferson	13.8	9.4	5.4	13.6	8.5	2.6
Total	59.8	44.7	29.9	58.3	47.8	21.7
Average of Summer and Winter Surveys	59.1	46.3	25.8			
	Corridor Counties					
Counties	Idaho Springs	Frisco	Vail	Idaho Springs	Frisco	Vail
Clear Creek	1.9	0.6	0.2	3.5	0.4	0.1
Eagle	5.5	11	37.9	2.5	7.8	42.8
Garfield	1.2	3.2	2.7	1.1	2.5	2.2
Summit	4.9	3.5	1.4	2.8	3.9	1.1
Park	0.3	0.2	0.2	0.3	0.2	0.1
Lake	0.6	2.7	0.4	0.5	2.6	0.7
Grand	1.6	0.2	0.1	1.5	0.2	0.1
Gilpin	0.1	0.1	0	0.4	0.1	0.1
Pitkin	0.4	0.9	0.4	0.4	0.8	0.7
Total	16.5	22.4	43.3	13	18.5	47.9
Average of Summer and Winter Surveys	14.8	20.5	45.6			
	South Front Range Counties					
Counties	Idaho Springs	Frisco	Vail	Idaho Springs	Frisco	Vail
Pueblo	0.3	0.3	0.3	0.1	0.3	0.2
El Paso	2.8	3.1	2.6	2.5	3	2
Teller	0.1	0.1	0.1	0	0.1	0.1
Fremont	0.1	0.1	0	0.1	0.1	0
Total	3.3	3.6	3	2.7	3.5	2.3
Average of Summer and Winter Surveys	3.0	3.6	2.7			
	North Front Range Counties					
Counties	Idaho Springs	Frisco	Vail	Idaho Springs	Frisco	Vail
Larimer	2.3	2.2	1.3	2.5	1.9	1
Weld	1.1	1.4	0.7	1	0.9	0.5
Total	3.4	3.6	2	3.5	2.8	1.5
Average of Summer and Winter Surveys	3.5	3.2	1.8			
	North Front Range Counties					
Origin	Idaho Springs	Frisco	Vail	Idaho Springs	Frisco	Vail
Out of State	10	16	16	19	21	22
Total	10	16	16	19	21	22
Average of Summer and Winter Surveys	14.5	18.5	19			

4.7.4 Level 2 Screening

Further evaluation of the remaining two Alternate Routes was done at Level 2 and focused on more detailed analysis of travel time as well as construction costs and environmental impacts.

Alternate Route 9 uses US 285 between Denver and Copper Mountain and a new tunnel under Georgia Pass. Alternative Route 9 was eliminated at Level 2 for the following reasons:

- Substantial impacts to natural and cultural resources in southern Park County. This Alternate Route includes 4.3 miles of road widening and 9 miles of new road construction within the South Park National Heritage Area (recently designated by the National Park Service); 16 acres of wetland impact, many of which are fens; direct impact to two National Register properties: the Wahl Ranch and Jefferson Denver South Park and Pacific Railroad Depot; likely impact to three other potentially historic ranches; and likely impact to the Kenosha Pass Summit, which is on the State Register of Historic Places. The new two lane road northwest from Jefferson under Georgia Pass to north of Breckenridge affects 28 acres of lynx habitat, 91 acres of key elk habitat and 133 acres of key deer habitat. It traverses 60 acres of U.S. Forest Service Land, three of which are in designated roadless areas and almost 6 acres of which are in State Wildlife Areas. It also affects 3,500 feet of streams, protected by the Clean Water Act.
- Noticeably slower uncongested travel time compared to the I-70 highway uncongested travel. Travel on Alternate Route 9 would take 118 minutes (compared to 74 minutes on the I-70 highway) during uncongested travel times.
- High costs of $520 million to build a new 10,600 foot two-lane tunnel under Georgia Pass.

Alternate Route 17 uses a new tunnel parallel to the Moffat Tunnel, was eliminated at Level 2 because of the costs of developing a new tunnel (estimated at $650 million [2000 dollars]) and because of its noticeably slower travel time. Travel on Alternate Route 17 takes 197 minutes (compared to 109 minutes on the I-70 highway) during uncongested travel periods. During congested travel periods, Travel on Alternate Route 17 takes 244 minutes compared to 165 minutes on the I-70 highway.

4.7.5 Level 3 Screening

Level 3 screening was not conducted since all Alternate Routes were eliminated during Level 1 and Level 2 screening.

4.7.6 Summary

None of the seventeen Alternate Routes developed provide a sufficient alternate travel route to the I-70 highway avoiding the need to improve mobility along the I-70 highway. This information was presented at public workshops in January 2001 and at Advisory Committee meetings in February 2001, with the recommendation that Alternate Routes be eliminated. Attendees at each forum endorsed this recommendation and results of this screening were announced in the June 2001 newsletter.

The results of the screening process for the Alternate Route Alternative Elements are summarized in **Table 11**.

Table 11. Alternate Route Alternative Elements

Alternate Route	Screened—Level 1 Screening	Screened—Level 2 Screening	Screened—Level 3 Screening	Advanced for Action Alternative Development
Alternative Route 1: Fort Collins to Wolcott via Walden (SH 14 and SH 131)	X			
Alternate Route 2: Fort Collins to Wolcott via Kremmling (US 34)	X			
Alternate Route 3: Fort Collins to Copper Mountain via Kremmling (US 34 and SH 9)	X			
Alternate Route 4: Denver to Wolcott via Moffat Tunnel (SH 72, US 40, and US 34)	X			
Alternate Route 5: Denver to Copper Mountain via Moffat, Berthoud and Jones Pass Tunnels (SH 72 and SH 9)	X			
Alternate Route 6: Denver to Wolcott via Berthoud Pass Tunnel (US 40 and US 34)	X			
Alternate Route 7: Denver to Copper Mountain via Jones Pass Tunnel (SH 9)	X			
Alternate Route 8: Denver to Copper Mountain via Hoosier Pass (surface) (US 285 and SH 9)	X			
Alternate Route 9: Denver to Copper Mountain via Georgia Pass Tunnel (US 285)		X		
Alternate Route 10: Denver to Minturn via Buena Vista (US 285 and US 24)	X			
Alternate Route 11: Colorado Springs to Copper Mountain via Hoosier Pass (surface) (US 24 and SH 9)	X			
Alternate Route 12: Colorado Springs to Copper Mountain via Hoosier Pass Tunnel (US 24 and SH 9)	X			
Alternate Route 13: Colorado Springs to Minturn via Buena Vista (US 24)	X			
Alternate Route 14: Colorado Springs to Copper Mountain via Buena Vista (US 24 and SH 91)	X			
Alternate Route 15: Pueblo to Copper Mountain via Hoosier Pass (surface) (US 50 and SH 9)	X			
Alternate Route 16: Pueblo to Copper Mountain via Hoosier Pass Tunnel (US 50 and SH 9)	X			
Alternate Route 17: Golden to Winter Park via New Tunnel Parallel to Moffat Tunnel (SH 58, SH 93, and SH 72)		X		

4.8 Aviation Alternative Elements

4.8.1 Introduction

Aviation alternative elements focus on meeting future travel demand and increasing mobility within the Corridor. Greater air passenger travel has the potential to remove cars from the highway. Aviation alternative elements were developed from various sources including Federal Aviation Administration (FAA) data, the Colorado Division of Aeronautics within the Colorado Department of Transportation (CDOT), aviation and airport managers from the I-70 Mountain Corridor airports, and AirNav data (an online aeronautical information source).

The aviation alternative elements are predominantly capital improvement oriented. It is important to consider how capital-intensive alternative elements could occur. For example, many airports in Colorado are under the direction of local airport authorities, county commissioners, and city elected officials.

Compared with other states, the planning and implementation of Colorado's transportation systems have been heavily weighted toward highway systems rather than its air transportation systems. The Colorado Department of Transportation conducts planning for alternative modes and aeronautics. The Colorado Department of Transportation's role in aviation and determining the siting of new airports or improvements to existing airports has been one of a coordinating agency, as opposed to a lead agency.

The cost and implementation of market-based strategies such as "seat guarantees" and flight scheduling fall to private sector entities such as the airlines and resort operators. A strong partnership with the local community's chambers of commerce and public sector entities is critical. The policy needed to implement these strategies must evolve from a process that results in buy-in and willingness on the part of the stakeholders to financially support the strategies.

4.8.2 Alternative Elements Evaluated

The following six Aviation alternative elements were evaluated:

- **Improvement of existing commercial service aviation facilities through advanced technology.** This element includes a variety of improvements to the Aspen-Pitkin County/Sardy Field Airport, Eagle County Regional Airport, and Yampa Valley Regional Airport allowing the airports to accommodate greater commercial airline service. These improvements include longer runways and the addition of crosswind runways that allow more planes to land under challenging wind conditions.

  Additionally, advances in aircraft technology and performance offer greater capacity as aircraft can be accommodated during more types of weather. For example, higher output engines with greater climb capabilities allow aircraft to operate at higher altitudes where previously long runways were needed to obtain the lift necessary for flight.

  These proposed improvements include:

  - Increased ability of users to fly more direct routes
  - Expanded surveillance coverage
  - Clearer, less congested, air/ground communications
  - Optimized flight profiles
  - More efficient sequencing of air traffic
  - Accurate and timely weather and traffic information in the cockpit

- **Improvement of existing general aviation facilities to accommodate commercial operations.** This element includes improvements to Lake County Airport in Leadville, Glenwood Springs Municipal Airport, or Kremmling Airport (formerly McElroy Field). Similar to improvements to existing commercial service airports, improvements to general aviation facilities include lengthening runways, strengthening runway pavement, adding cross-wind runways, adding instrument flight rules or precision instrument landing capabilities, and staffing air traffic control towers.
- Similar to improving commercial service airports, the increased capacity at general aviation facilities is expected to accommodate travel demand in the Corridor and mobility on the I-70 highway could improve as more cars are diverted from the highway to air transportation. Airports with better runway facilities and enhanced technologies can accommodate larger aircraft and better deal with the unpredictability and hazards of mountain weather.
- **Development of aviation systems management and subsidy programs.** Includes scheduling techniques combining two or more destinations on the same flight and the use of seat guarantees or subsidies to encourage air travel. This alternative element is very similar to what is known as transportation demand management where a variety of strategies are implemented to encourage or

discourage single-occupant vehicle driving. Aviation examples are market-based solutions such as when fare subsidies result in empty seats being paid for or passenger fares are "bought down." Another strategy is guaranteed revenue to airlines, offered to encourage people to fly and to encourage airlines to continue otherwise unprofitable flights. In some cases, both incentives may be offered.

Another market-based strategy is the combining of two destinations into one flight. For example, an airline could make stops at Aspen-Pitkin County/Sardy Field and Yampa Valley Regional Airport and serve two destination markets. Flights from U.S. cities to destinations in Mexico are often combined in such a fashion (e.g., Cancun and Cozumel on the Yucatan Peninsula). The FAA has undertaken a long-term effort known as the National Airspace System (NAS) Modernization to accommodate air traffic growth and meet the increased safety and efficiency demands placed on the air traffic control system. These proposed improvements include:

- Increased ability of users to fly more direct routes;
- Expanded surveillance coverage;
- Clearer, less congested, air/ground communications;
- Optimized flight profiles;
- More efficient sequencing of air traffic; and
- Accurate and timely weather and traffic information in the cockpit.
- National Airspace System (NAS) Modernization strategies are market-based solutions. For example, the ability to combine two destinations on one flight is enhanced as NAS Modernization offers greater route flexibility and improved planning for fuel- and time efficient flight plans. As modernization contributes to more choices and lower operating costs for airlines, it benefits the air transportation consumer with more alternatives and affordable fares.

- **Development of new airports in the Corridor.** This element provides the siting and construction of new airports at appropriate locations in the Corridor, with new terminal, airfield and landside facilities (e.g., parking lots or rental car facilities). The airports are designed to accommodate commercial service and allow access to the national air system and potential all-weather capability very similar to Aspen-Pitkin County/Sardy Field, Eagle County Regional Airport, Walker Field, and Yampa Valley Regional Airport. For more information on the characteristics and operations of each of these airports, see **Appendix G**, *I-70 Mountain Corridor Air Service Characteristics & Operational Inventory*.

  With regard to capacity, the new airport(s) are designed with sufficient and appropriate land in the Corridor where the terrain is relatively flat and reasonably unconstrained. Mobility/accessibility is addressed as the airport is sited in proximity to major activity centers. Airport safety is better as larger airports with greater runway capacity and air traffic control ability are safer compared to smaller airports. Extremes of weather and terrain are unchanged, but larger aviation facilities and enhanced technologies can accommodate larger aircraft better equipped to handle these challenges.

- **Development of new heliport and short takeoff-and-landing (STOL) facilities.** This element provides new or upgraded aviation facilities that accommodate vertical flight aircraft such as rotorcrafts, tiltrotors and tilt-wing aircraft. These facilities are constructed at existing commercial service and general aviation (flights other than military, scheduled airline, or regular cargo flights) airports, but require exclusive heliport pads independent of the runways. Special hangars and tie-downs also are necessary for storage of these types of aircraft.

- **Development of Walker Field (Grand Junction) into a Western Slope regional hub airport.** This element includes expansion of the Walker Field airport to provide access to the national air transportation system, similar to Colorado's two existing hub airports, Denver International Airport and Colorado Springs Airport. Similarly, Walker Field's runways are lengthened to twice their existing lengths and larger hangar facilities and terminal amenities are added to accommodate greatly increased air passenger activity.

4.8.3 Level 1 Screening

Aviation alternative elements were evaluated for technological feasibility and logistical application. Because implementation required consideration of land suitability for new aviation facilities or expansion of existing facilities, there is insufficient need to develop new airports or expand on existing facilities since there is excess capacity now and implementation was not a factor in screening.

Level 1 evaluation criteria for aviation elements were analyzed for their ability to optimize travel based on the purpose and need and safety in the Corridor and included:

- **Capacity.** To determine the potential of an alternative element to offer additional capacity that meets the demand for mountain corridor travel, the lead agencies considered the feasibility of airport expansion or creation near activity centers that could potentially serve travel demand.
- **Mobility and Accessibility.** Alternative elements were measured relative to their contribution to enhanced mobility and accessibility in the Corridor. At this first screening level, mobility was evaluated based on interviews with Corridor airport managers compared with more typical applications in transportation planning where a mode is evaluated for its quantitative impact on traffic congestion (e.g., the number of people in cars removed from the road). Airport managers for the Corridor airports were contacted to get quantitative information. However, the FAA only collects information from large airports and corridor airport information was not readily available. See **Appendix H**, *I-70 PEIS Aviation Alternatives—Estimates of Auto Trips Diverted* (*memorandum)*. While it is intuitive that greater air passenger travel removes cars from the highway, accessibility to and from mountain corridor airports is critical to the viability of an airport. Therefore, with regard to an alternative element's impact on corridor mobility, in the case of construction of new airports or expansion of existing airports, a question was posed regarding reasonable proximity and accessibility to major activity centers in the Corridor.
- **Safety.** Alternative elements were evaluated relative to safety for air passengers as mountain corridor airports accommodate greater air service activity. Similar to mobility, safety—which is typically applied to an alternative element's ability to alleviate congestion and reduce highway crashes—was considered relative to the safety of the new or expanded aviation facility. In this case, safety was defined as airport safety by posing the question: Is the existing airport location (or general region intended for a new airport) free of major topographical and meteorological conditions that hamper air activity expansion? It is important to note that in the first level of screening, the criteria are used without regard for political acceptability or community values applied later in the environmental assessment stage. For purposes of this first level screening process, the alternative elements were evaluated in light of technological feasibility or logistical application. Moreover, the first level screening process is intended to *frame the issues.* This "framing of the issues" shapes the second level screening criteria and refines the process by which alternative elements were advanced.

The following Aviation alternative elements were eliminated due to the absence of demand for greater airport capacity and ability to reduce congestion or improve mobility and accessibility, and safety on the I-70 highway during peak travel demand periods:

- **Development of new airports in the Corridor.** Eliminated due to the lack of accessibility (e.g., not able to be sited in proximity to major activity centers) or insufficient air travel demand and inability to reduce congestion on the Corridor during peak travel demand periods. Aviation experts in the Corridor have indicated that commercial service capacity is not an issue in the Corridor. With improvements in radar equipment at the Eagle County Regional Airport and Aspen-Pitkin County/Sardy Field and runway extensions at the three commercial airports (Eagle County Regional Airport, Aspen-Pitkin County/Sardy Field, and Yampa Valley Airport), there is an estimated reduction of 500 person trips per day (or 192 vehicle trips per day using a 2.6 occupancy rate) within the next 15 years. This reduction provides minimal effects to the volume of traffic on the I-70 highway during peak travel demand periods. According to the *I-70 Mountain Corridor PEIS Travel Demand Technical Report*, approximately 2,400 vehicle trips must be removed from I-70 during peak travel demand periods at the Twin Tunnels to affect the I-70 highway. During off-peak periods, 1,500 vehicle trips need to be removed. See **Appendix H**, *I-70 PEIS Aviation Alternatives—Estimates of Auto Trips Diverted (memorandum)*.

- **Development of new heliport and STOL facilities.** Eliminated due to smaller aircraft that carry too few passengers are less equipped to deal with mountain weather conditions, and are unable to reduce congestion on the Corridor during peak travel demand periods.

  It is likely that greater capacity and the ability to meet travel demand are not realized, as vertical flight aircraft tend to be small and hold fewer passengers than traditional commercial aircraft. Additionally, vertical flight aircraft operate at half the speed of conventional aircraft and are noisier during take-off and landing. Likewise, the impact on mobility, based on qualitative analysis, is less as these types of aircraft hold fewer passengers, thus diverting an inconsequential number of cars from the highway.

  With regard to safety, vertical flight aircraft, as compared to conventional large aircraft, are less equipped to deal with the extremes of mountain weather conditions such as ice, snow and wind.

- **Development of Walker Field into a Western Slope regional hub airport.** Eliminated because it has available capacity that is currently underutilized compared to Hayden, Rifle, Aspen, Eagle County, and Glenwood Springs airports and because it is unable to reduce congestion on the Corridor during peak travel demand periods.

  Until the development of Aspen-Pitkin County/Sardy Field, Eagle County Regional Airport, and Yampa Valley Regional Airport as regional commercial service airports, Walker Field served as the gateway airport to the mountain resort communities and an alternative to Denver International Airport. It is unlikely that Walker Field will resume its position as a hub or gateway airport in light of the capacities of Aspen-Pitkin County/Sardy Field, Eagle County Regional Airport, and Yampa Valley Regional Airport, as well as technological advances making it increasingly safer to use the smaller, regional commercial service airports.

  Additionally, shifting the transport of goods from truck to aircraft historically has been deemed to have a minor impact on highway congestion given the small increase in capacity relative to the enormous cost (e.g., one plane carries about as much cargo as one truck).

The remaining Aviation alternative elements include:

- Improvement of existing commercial service aviation facilities through advanced technology;
- Improvement of existing general aviation facilities to accommodate commercial operations; and
- Development of aviation systems management and subsidy programs.

After Level 1 screening, the “Improvement of existing commercial service aviation facilities through advanced technology” and “Improvement of existing general aviation facilities to accommodate commercial operations” alternative elements were combined for comparative purposes because there was little difference between the two in the analysis of the evaluation criteria and the two elements are discussed under the improvements to commercial service aviation facilities element.

4.8.4 Level 2 Screening

Level 2 screening criteria included:

- **System capacity.** This was an estimate of the additional number of persons removed daily from the I-70 highway during the winter ski season. System capacity was obtained from the airport managers at Eagle County Regional Airport and Yampa Valley Regional Airport and officials at Denver International Airport.
- **Technology.** Technology assumes the next generation of navigational aids and radar surveillance.

Criteria for environmental sensitivity and community values were not applied to the aviation alternative elements at Level 2 screening. During the February and March 2001 Mountain Corridor Advisory Council meetings, a recommendation was made to advance the remaining two alternative elements to Level 3 screening. The recommendation focused on improved capacity of the aviation facilities in the Corridor through technological improvements, not physical improvements. The Council indicated that for the airports to remain viable for the purpose of removing traffic from the highway, they must be in the proximity and provide accessibility to major activity centers in the Corridor.

Based on the above criteria and the recommendation by the Mountain Corridor Advisory Council, the remaining two Aviation alternative elements were advanced to Level 3 screening.

In addition, as the result of Level 2 screening, the remaining two alternative elements evaluated technological advances and aviation systems management/subsidy programs at the Eagle County Regional Airport because it is the only airport located within the Corridor that influences capacity on I-70.

4.8.5 Level 3 Screening

Level 3 screening criteria included:

- **System capacity.** This was an estimate of the additional number of persons removed daily from the I-70 highway during the winter ski season. System capacity was obtained from the airport managers at Eagle County Regional Airport and Yampa Valley Regional Airport and officials at Denver International Airport.
- **Technology.** Technology assumed the next generation of navigational aids and radar surveillance.

The remaining two Aviation alternative elements were eliminated from consideration in the PEIS in Level 3 screening. These include the following elements:

- **Improvement of existing commercial service aviation facilities through advanced technology.** Eliminated from consideration because the capacity of commercial service is sufficient in the Corridor. Commercial service airport capacity is underutilized eight months out of the year and most facilities are designed for the peak winter season. Improvements to the Eagle County Regional Airport depend upon air travel demand and will be implemented independent of capacity demands on the I-70 highway. Also, advanced technology is considered to be part of the Eagle County Regional Airport's plans regardless of action on the I-70 highway.

  Greater capacity accommodates travel demand and is expected to alleviate Corridor congestion. Mobility is enhanced, and accessibility and proximity to activity centers is proven. Safety is expected to be improved as the existing commercial service airports are designed to accommodate large conventional aircraft of the type suitable for regional airports and thus are better equipped to deal with the challenges of mountain weather and terrain. However, as mentioned previously, capacity at commercial service airports is sufficient, and additional capacity is already available.

- **Development of aviation systems management and subsidy programs.** Eliminated due to the absence of demand for greater airport capacity and its inability to reduce congestion on the Corridor during peak travel demand periods. The Eagle County Regional Airport discontinued incentive programs and seat guarantees due to less seasonal fluctuations and growth in takeoffs and landings (enplanements) over the past ten years.

4.8.6 Alternative Elements Advanced for Evaluation in the PEIS

No aviation alternative elements were advanced for evaluation in the PEIS. However, enhancements to radar equipment at the Eagle County Regional Airport are part of their plans regardless of action on the I-70 highway.

4.8.7 Summary

The results of the evaluation process for the Aviation alternative elements are summarized in **Table 12**.

Table 12. Aviation Alternative Elements

Aviation Alternative Element	Screened—Level 1 Screening	Screened—Level 2 Screening	Screened—Level 3 Screening	Advanced for Action Alternative Development
Improve Existing Commercial Service Aviation Facilities Through Advanced Technology (Included in Local Airport Planning)			X	
Improve Existing General Aviation Facilities to Accommodate Commercial Operations*	1			
Develop Aviation Systems Management and Subsidy Programs			X	
Develop New Airports in the Mountain Corridor	X			
Develop Heliport and Short Takeoff and Landing Facilities	X			
Develop Walker Field (Grand Junction) into a Western Slope Regional Hub Airport	X			

[1]Alternative element combined with "Improve Existing Commercial Service Aviation Facilities Through Advanced Technology" alternative element, which was eliminated during Level 3 screening.

4.9 Tunnel Alternative Elements

4.9.1 Introduction

Tunnels were evaluated in specific locations to improve mobility or provide additional capacity as part of highway or transit improvements. New tunnels also were considered to improve geometry and address safety problems in locations where design speed and roadway geometry required. Additional bores and/or widening reconstruction were evaluated at existing tunnels that do not provide adequate capacity. **Figure 6** shows alignments for both new and expanded tunnels considered.

4.9.2 Alternative Elements Evaluated

New Tunnels Proposed to Accommodate Transit

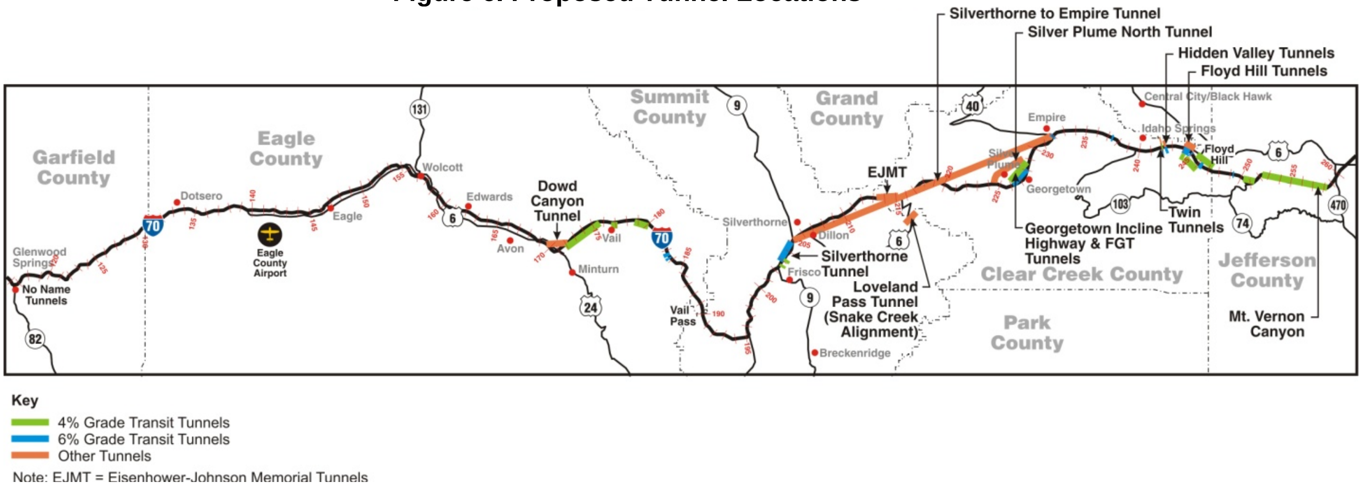
- **Silverthorne Tunnel.** This tunnel is required to accommodate transit alternatives that must operate on a 6 percent grade or less. A tunnel located from mileposts 205.5 to 207.7 (approximately 11,500 feet in length) along the north side of the interstate is required to maintain these grades.
- **Loveland Pass Tunnel (Snake Creek Alignment).** The Snake Creek alternative element deviated from the I-70 highway platform and traveled along the Snake Creek watershed rather than the Straight Creek watershed. This element is considered for capacity improvements and accommodates transit alternatives operating on a 6 percent grade or less, particularly for the Fixed-Guideway Transit alternative elements.
- **Silver Plume North Tunnel.** This new tunnel is proposed to accommodate additional capacity provided by transit alternative elements. The tunnel is proposed to bypass the town of Silver Plume to the north. The west portal for the tunnel alternative is located near the Burleigh Tunnel, historically used for mining operations. The east portal is located east of the Georgetown interchange.
- **Georgetown Incline Tunnel.** The Georgetown Incline Tunnel alignment is considered for capacity improvements, particularly for the Fixed-Guideway Transit alternative elements between Georgetown and Silver Plume. This tunnel is required to accommodate transit alternatives that must operate on a 6 percent grade or less. This tunnel is located east of Silver Plume interchange at milepost 226.6 and east of the Georgetown interchange for the east portal at milepost 228.2 for a total length of 2.6 miles.
- **Mount Vernon Canyon Tunnel.** The Mount Vernon Canyon Tunnel begins at C-470 and extends westbound resulting in a 6.2-mile-long tunnel associated with Fixed-Guideway Transit alternative elements on 4 percent grades. .

See **Figure 6** for an illustration of the proposed new transit tunnel locations.

New Tunnels Proposed to Accommodate Highway

- **Georgetown Incline Tunnel.** This tunnel alignment provides a single three-lane bore for the Highway Widening alternative elements. The westbound traffic travels in the new tunnel, and eastbound traffic follows the existing I-70 highway alignment. The tunnel was evaluated to operate at a 4 percent grade. Generally, highway tunnels longer than 800 feet are limited to 3 percent grades because of ventilation requirements. The Georgetown Incline Tunnel was evaluated using up to a 4 percent grade and still provides a potential to meet the necessary grade requirement for the transportation purposes. The east portal for the 4 percent grade would be located on the north side of the I-70 highway across from Georgetown Lake. The west portal was located on the north side of the I-70 highway across from the Silver Plume station of the Georgetown Incline Railroad. This alternative element was proposed between Georgetown and Silver Plume because this area was identified as a problematic area due to the curves and substandard roadway geometry. Early in the NEPA process, a two bore tunnel system was considered here for eastbound and westbound traffic.
- **Dowd Canyon Tunnel.** This tunnel is needed to accommodate the design speed with the 65 mph Highway Alternative. The new tunnels in this location consists of options for one or two new three-lane tunnels—one to accommodate westbound traffic, the other for eastbound traffic. The east portal is located near milepost 172 and the west portal is located near milepost 170 west of Vail. This alternative element was proposed because Dowd Canyon was identified as a problematic area due to the substandard curves and need for capacity. These tunnels are anticipated to be approximately 5,460 to 7,200 feet long.

Figure 6. Proposed Tunnel Locations



- **Hidden Valley Tunnel.** This tunnel is needed to accommodate the design speed with the 65 mph Highway Alternative. The new tunnel in this location consists of one new three-lane tunnel that accommodates westbound traffic only. This tunnel is anticipated to be approximately 1,400 to1,500 feet long. This tunnel is located east of the Twin Tunnels between mileposts 242 to 243 to accommodate additional highway capacity and a 65 mph design speed. The eastbound tunnel generally follows the existing alignment but requires curve safety modification in select locations to maintain the 65 mph design speed.
- **Floyd Hill Tunnel.** This tunnel is located west of Floyd Hill between mileposts 244 to 247. This tunnel was proposed to accommodate additional highway capacity and a 65 mph design speed. This new three-lane tunnel accommodates eastbound traffic only and the westbound traffic follows existing I-70 highway platform. This tunnel is anticipated to be approximately 5,500 feet long and is associated with the 65 mph Highway Alternative. If the I-70 highway platform is not used for the westbound traffic, an option of a second three-lane bore in this location can be considered.
- **Silverthorne to Empire Tunnel.** This tunnel is 25 miles long and is required to provide additional capacity for the highway. It runs below the Eisenhower-Johnson Memorial Tunnels at an elevation of 8,500 to 8,800 feet, approximately 4,000 to 4,500 feet below the elevation of the Continental Divide. It was evaluated with the Highway alternative elements as a separate highway alternative to avoid steep grades at the Continental Divide. Please see **Section 4.6** for the screening analysis of this tunnel as part of a highway alternative element.
- **Other Highway Tunnels Proposed.** Various locations to construct tunnels other than the Eisenhower-Johnson Memorial Tunnels that cross the Continental Divide were considered but eliminated because of considerable environmental impacts of adding a new transportation corridor to land where current access is limited or nonexistent to motorized vehicles. New alignments ranged from Georgia Pass to the south and Rawlins Pass to the north. Please see **Section 4.7** for the screening analysis of these tunnels associated with Alternate Routes.

Existing Tunnels

- **Eisenhower-Johnson Memorial Tunnels.** The existing Eisenhower-Johnson Memorial Tunnels are located between mileposts 213 and 216. Options for additional capacity at the Eisenhower-Johnson Memorial Tunnels included widening existing tunnels, adding a new bore to the north, and adding a new bore to the south for transit alternatives, highway alternatives or both. The lengths of the tunnels considered range from 11,845 feet to 14,465 feet.

- **Twin Tunnels.** The existing Twin Tunnels are located between mileposts 242 and 243. The length of the additional two to three lane bore is about 3,450 feet. An additional tunnel is needed for additional capacity and is associated with all of the highway and transit alternative elements. Single mode alternatives need a new bore for the additional capacity, highway or transit. Combined highway and transit alternatives require not only an additional three lane bore, but reconstruction widening of the westbound bore to accommodate three lanes of highway traffic. The remaining eastbound bore is used for the transit mode. The proposed third tunnel bore is located to the south of the existing tunnel bores.

4.9.3 Level 1 Screening

Tunnel alternative elements were not developed during the Level 1 screening. This is because tunnel alternative elements were not considered as a separate "standalone" element required to address purpose and need, but rather an "infrastructure" feature to enable alternatives to operate in the Corridor. Tunnel elements were evaluated in conjunction with highway and transit alternative elements to address roadway geometry requirements, operational requirements, and additional capacity.

4.9.4 Level 2 Screening

Level 2 screening evaluated the tunnels in association with development of highway and transit alternative elements. Tunnels were developed in association with alternative elements to meet design and operational requirements in order to meet purpose and need. The Level 2 screening criteria did not focus on eliminating tunnels if they did not meet certain criteria, but rather on comparing highway and transit alternative families to each other to understand which alternative elements had the best opportunities to meet purpose and need. A number of alternative elements requiring tunnels could not be implemented or a result of implementation resulted in extraordinary environmental and community impacts.

A major consideration of the tunnel evaluation was operational (grade limitations) requirements for highways and transit; Fixed-Guideway Transit alternatives that must operate on a 6 percent grade or less. Generally, for highway tunnels longer than 800 feet a 3 percent grade is preferred due to increased vehicle emissions and corresponding ventilation requirements. The 4 percent and 6 percent grades were used as the two design grades for the Fixed-Guideway Transit alternative elements. Tunnels were only evaluated (and eliminated or advanced) in conjunction with highway and transit alternative elements. For results of the Level 2 screening which included tunnel elements, see **Sections 4.4, 4.6 and 4.7.**

The following evaluations were considered in the overall transit and highway alternative evaluations:

- **Widening the Eisenhower-Johnson Memorial Tunnels.** All of the alternatives considered to date include crossing the Continental Divide near the existing Eisenhower-Johnson Memorial Tunnels. Techniques for widening the existing Eisenhower-Johnson Memorial Tunnels were considered but eventually dropped due to extensive impacts to traffic and constructability. The existing tunnels utilized a multiple drift system for the support of the tunnel through the Loveland Shear Zone prior to the installation of the final tunnel lining. This geologic feature posed many difficulties including squeezing rock, loss of equipment, tunnel collapse, floor heave (where the floor of the tunnel rises up due to the nature of the incompetent material and the pressure of the surrounding rock) during the original construction. The amount and type of reinforcement to hold the tunnel open exceeded the planned quantities and strengths. All of these problems added additional cost and time to the completion of the tunnels. To widen the existing tunnels, all of the existing support systems must be removed during the widening process leaving an unsupported portion of tunnel for an undesirable length of time. Staging the new support system with the removal of the existing systems and coupled with the extremely difficult ground conditions led to elimination of widening the Eisenhower-Johnson Memorial Tunnels because it was not feasible to implement.

Specific tunnels were associated with a number of transit alternative elements evaluated and eliminated during Level 2 screening. Tunnels associated with transit alternative elements on 4 percent and 6 percent alignments were grouped with those alternatives for Level 2 screening analysis. These tunnels, associated with Fixed-Guideway Transit alternative elements include:

- **Silverthorne Tunnel.** Evaluated for 6 percent (or less) grade transit alternative elements. The area surrounding the towns of Silverthorne and Frisco presents the greatest challenge due to the presence of Dillon Reservoir, steep topography, and adverse subsurface conditions. Construction of this tunnel requires excavation in thick unconsolidated glacial sediments underlain by high groundwater tables. The constructability of tunneling in these conditions as analyzed and tunnels were not constructible due to geologic hazards and engineering construction difficulties in shale and fault zones. Fault zones increase the risk of instability to support tunnel walls. This tunnel is associated with some of the Fixed-Guideway Transit alternative elements considered on the 4 percent and 6 percent grades and did not meet the minimum criteria to be evaluated in the PEIS. See **Section 4.4** for more information.
- **Loveland Pass Tunnel (Snake Creek Alignment).** Analysis concluded that because of the elevation required for both the east and west portals, the grade required for the tunnel approach is too steep (estimated to be at a 9 percent or 10 percent grade) for the practical operation of Fixed-Guideway Transit systems. The Fixed-Guideway Transit systems require a 6 percent grade or less to operate. This alternative element impacted several properties including wilderness areas and recreational areas and trails outside the I-70 Mountain Corridor. Constructing the new tunnel requires steep grades to access both of the new portals. This results in unacceptable operational problems. Severe impacts might occur to numerous environmental and socio-economic resources (including bisecting the proposed Porcupine Gulch Wilderness Area, creating major conflicts with central operations of the Loveland Ski Area, which might result in likely removal of all ski area operations, and substantial new impacts to the Snake Creek watershed) due to construction of a new transportation corridor located over the Continental Divide. This tunnel it is not constructible due to the inability to operate on the steep grades and because of unacceptable environmental impacts. This tunnel is associated with some of the Fixed-Guideway Transit alternative elements considered on the 4 percent and 6 percent grades and did not meet the minimum criteria to be evaluated in the PEIS. See **Section 4.4** for more information.
- **Georgetown Incline Tunnel.** Any tunnels associated with Fixed-Guideway Transit alternative elements operating on 6 percent grade or less result in numerous severe environmental impacts, extraordinary costs, and potential constructability issues. Both portals of this tunnel are located in Big Horn Sheep winter and summer ranges. The area around milepost 226.6 (west portal) is a known Big Horn Sheep lambing area. The structures needed for the Rail and Advanced Guideway System grade likely require an elevated structure through the town of Silver Plume to cross Clear Creek and the I-70 highway. These structures are more visible to the town and the Silver Plume station of the Georgetown Loop Railroad as compared to the on-grade rail/Advanced Guideway System alignments that follow the south side of the I-70 highway. This tunnel is associated with some of the Fixed-Guideway Transit alternative elements considered on the 4 percent and 6 percent grades and did not meet the minimum criteria to be evaluated in the PEIS. See **Section 4.4** for more information.
- **Silver Plume North Tunnel.** Analysis conducted for this tunnel concluded that due to mine workings along the proposed alignment, there are multiple drifts present at this location and unstable openings would be encountered during the tunnel excavation. Unstable openings contribute to the potential for mine collapse. For this reason, conventional tunneling techniques are not appropriate. It is unclear if this tunnel could ever be safely constructed. The cost of constructing the tunnel is estimated to be $60,000 per lineal foot if construction could occur. The location and extent of mine workings are not known. Mine workings encountered during

construction of the new bore require many of the workings to be plugged and closed with a cement-like material. It is unknown how much water would be intercepted by the new bore. As with the historic Burleigh Tunnel (a known Superfund site) located nearby, the new tunnel provides a drainage conduit for water containing heavy metals. The cost to mitigate potential mine collapse and poor water quality is not known. This tunnel is associated with some of the Fixed-Guideway Transit alternative elements considered on the 4 percent and 6 percent grades and did not meet the minimum criteria to be evaluated in the PEIS. See **Section 4.4** for more information.

- **Mount Vernon Canyon Tunnel.** The Mount Vernon Canyon Tunnel begins at C-470 and extends westbound resulting in a 6.2-mile-long tunnel associated with Fixed-Guideway Transit alternative elements on 4 percent grades. It was eliminated from further consideration because it would be costly to construct and was not necessary, as the Fixed-Guideway Transit alternative elements that required 4 percent grades were eliminated for other reasons (e.g., capacity, speed, and operational characteristics). See **Section 4.4** for more information.

The following tunnels are associated with Highway Alternative elements:

- **Georgetown Incline Tunnel.** Analysis conducted for this tunnel revealed mine workings along the proposed alignment and unstable openings that would be encountered during tunnel excavation. Unstable openings contribute to the potential for mine collapse. The location and extent of mine workings are not known. Groundwater encountered in the tunnel requires a water treatment facility. The extent of mine openings and groundwater contamination are not known. Cost to mitigate potentially unstable mine workings and poor water quality are not known. Additionally, road icing poses a problem at tunnel portals and can lead to major safety issues when combined with steep grades. For these reasons, the highway tunnel was limited to 4 percent grade, resulting in a longer tunnel than the highway alignment, which is a steeper grade. Typical highway grades in tunnels are limited to 3 percent to provide adequate ventilation. Both portals of this tunnel are located in Big Horn Sheep winter and summer range. The area around milepost 226.6 (west portal) is a known Big Horn Sheep lambing area. This alignment provides a means to construct rockfall mitigation in one of the worst areas of rockfall in the state. However, the noise from the ventilation complex and eastbound traffic continues on the existing corridor. A two bore, six-lane highway tunnel system was considered but was eliminated in the early screening process due to the limited space in the west portal area and the massive ventilation facility required. The facility would be seen and heard from Silver Plume and the Georgetown Loop Railroad. This tunnel is associated with highway improvements between Georgetown and Silver Plume; see **Section 4.6** for more information.
- **The Georgetown Incline Tunnel.** This tunnel was considered to avoid potential impacts to the towns of Silver Plume and Georgetown and associated resources.

The following alternative elements were eliminated during Level 2 screening:

- Silverthorne Tunnel
- Silverthorne to Empire Tunnel
- Loveland Pass (Snake Creek Alignment) Tunnel
- Silver Plume North Tunnel.

Although the Georgetown Incline Tunnels were initially eliminated due to severe issues in encountering existing mining tunnels containing water with heavy metals, as well as construction and operational safety issues, they were retained later during the PEIS process for consideration for mitigation of noise and minimizing impacts to historic properties in Tier 2.

The following tunnel alternative elements were advanced for evaluation in Level 3 as part of the highway and transit alternatives:

- Dowd Canyon Tunnel—Highway
- Georgetown Incline Tunnel—Highway
- Floyd Hill Tunnel—65 mph Highway
- Hidden Valley Tunnel—65 mph Highway
- Eisenhower-Johnson Memorial Tunnels—Highway or Transit
- Twin Tunnels—Highway or Transit

4.9.5 Level 3 Screening

Tunnel elements of the alternatives were not evaluated during the Level 3 screening. This is because the tunnel element was not considered as a separate "standalone" element required to address purpose and need, but rather an "infrastructure" feature to enable alternatives to operate in the Corridor. Tunnel elements were evaluated in conjunction with highway and transit alternative elements to address, roadway geometry requirements, operational requirements and additional capacity and advanced for inclusion in the PEIS. The Eisenhower-Johnson Memorial Tunnels were evaluated separately during Level 3 Screening for their potential to avoid impacts to historic resources and Section 4(f) properties at Loveland Ski Area.

- **Eisenhower-Johnson Memorial Tunnels (north alignment).** A northern alignment may reactivate a landslide triggered during initial construction. Extensive slope stabilization is required and the subsurface materials are in poor condition. Construction of a northern bore encounters a shear zone creating enormous pressure and requires a large amount of support structure and encounter a high groundwater table. This bore is approximately 13,725 feet in length.
- **Eisenhower-Johnson Memorial Tunnels (south alignment).** Construction of a southern bore encounters a shear zone, creating an enormous amount of pressure and could lead to destabilization of rock. To avoid destabilizing rock around the existing bore which continues to carry traffic during construction new bores would have to be located at least 120 to 250 feet from the existing tunnel. A new south bore is anticipated to be approximately 10,500 feet long and a north bore approximately 13,725 feet long. Both bores result in impacts to the Loveland Ski area. The construction of a south bore results in considerable impact to the function of the Loveland Ski Area. Therefore, the proposed bore to the south of the existing tunnel was eliminated at this level of analysis.

The northern alignment was selected for consideration in the PEIS for the best opportunity to avoid impacts to the Loveland Ski Area (a known Section 4(f) property). However, the southern alignment is retained for consideration in the Tier 2 process to further evaluate constructability issues. Preliminary analysis is not conclusive regarding which alignment is easier to construct.

4.9.6 Summary

The results of the evaluation process for Tunnels are summarized in **Table 13**.

Table 13. Tunnel Alternative Elements Advanced for Evaluation in PEIS

Tunnel Alternative Element	Screened—Level 1 Screening	Screened—Level 2 Screening	Screened—Level 3 Screening	Advanced for Action Alternative Development
Proposed New Tunnels				
Dowd Canyon Tunnel				✓
Silverthorne Tunnel		X		
Silverthorne to Empire Tunnel—Highway		X		
Loveland Pass Tunnel—Fixed-Guideway Transit		X		
Silver Plume Tunnels		X		
Silver Plume—North Tunnel—Fixed-Guideway Transit		X		
Georgetown Incline Tunnel—Fixed-Guideway Transit				✓
Georgetown Incline Tunnel—Highway				✓[1]
Twin Tunnels to Hidden Valley				✓
Hidden Valley to Floyd Hill				✓
Mount Vernon Canyon Tunnel—Fixed-Guideway Transit		X		
Third Bores at Existing Tunnels				
Eisenhower-Johnson Memorial Tunnel				✓
Twin Tunnels				✓[2]

[1]Retained in the PEIS for consideration for the Tier 2 processes.

[2]Twin Tunnels for combined alternatives includes one new bore for three-lanes of highway traffic and reconstruction of the westbound tunnel to accommodate three-lanes of highway traffic. Transit would use the remaining tunnel.

FGT = Fixed-Guideway Transit

Section 5. PEIS Alternatives

The elements of alternative families that advanced through the screening process were packaged into the components of the Action Alternatives for analysis in the PEIS as described below.

5.1 Minimal Action Alternative

The Minimal Action Alternative provides a range of local transportation improvements along the Corridor without providing major highway capacity widening or dedicated transit components. The Minimal Action Alternative addresses specific roadway problem areas identified throughout the Corridor. These improvements include:

- A transportation management program
- Interchange modifications
- Auxiliary lanes for slow-moving vehicles
- Curve safety modifications
- Sediment control programs
- Frontage road improvements
- Bus service in mixed traffic

Chapter 2 of the PEIS shows these improvements by area. All or portions of this alternative are added to the other Action Alternatives and could proceed as early action projects (see **Introduction** of the PEIS).

Transportation Management Program

The Transportation Management Program includes components identified as part of the transportation management family and includes minor improvements to improve operational efficiency without major capacity additions. Transportation management includes:

- TDM
- TSM
- ITS

What is TDM / TSM / ITS?

- TDM increases roadway effectiveness by encouraging traveler behaviors that reduce vehicular demand during peak periods, such as ridesharing and telecommuting.
- TSM improves the operation of the physical roadway infrastructure, through the use of ramp metering (regulates the amount of traffic entering freeways through the use of a traffic signal based on traffic conditions) and traffic operations plans.
- ITS uses advanced applications of electronics and communications to achieve TSM and TDM goals, such as enhanced traveler information and variable message signs.

Interchange Modifications

A majority of the interchange bridges in the I-70 Mountain Corridor are structurally deficient, functionally obsolete, or will be by 2035. Twenty-five interchange locations along the Corridor were identified as needing improvements and are included as part of this alternative. The existing or future problems at each interchange vary widely and are described further in the I-70 Mountain Corridor PEIS Transportation Analysis Technical Report (CDOT, August 2010). The interchanges are:

- Glenwood Springs (milepost 116)
- Gypsum (milepost 140)
- Eagle & Spur Road (milepost 147)
- Edwards & Spur Road (milepost 163)
- Avon (milepost 167)
- Minturn (milepost 171)
- Vail West / Simba Run (milepost 173)
- Copper Mountain (milepost 195)
- Frisco/Main Street (milepost 201)
- Frisco/SH 9 (milepost 203)
- Silverthorne (milepost 205)
- Loveland Pass (milepost 216)
- Silver Plume (milepost 226)
- Georgetown (milepost 228)
- Empire (milepost 232)
- Downieville (milepost 234)
- Fall River Road (milepost 238)
- Idaho Springs West (milepost 239)
- Idaho Springs/SH 103 (milepost 240)
- Idaho Springs East (milepost 241)
- Base of Floyd Hill/US 6 (milepost 244)
- Hyland Hills (milepost 247)
- Beaver Brook (milepost 247)
- Lookout Mountain (milepost 256)
- Morrison (milepost 259)

Auxiliary Lanes

Auxiliary lane improvements proposed in 12 locations throughout the Corridor are part of the Minimal Action Alternative. Auxiliary lanes for slow-moving vehicles, primarily in locations of steep grades, increase the capacity of a highway by improving traffic flow for relatively short lengths.

- Eastbound auxiliary lanes are located
  - East of Avon
  - West side of Vail Pass
  - East of Frisco
  - East of Eisenhower-Johnson Memorial Tunnels
  - West of Georgetown
  - East of Empire
- Westbound auxiliary lanes are located:
  - In Mount Vernon Canyon
  - West of Downieville
  - West of Georgetown
  - On the approach to Eisenhower-Johnson Memorial Tunnels
  - West side of Vail Pass

Curve Safety Modifications

Curve safety modifications are proposed in four locations in the Corridor and include increasing the design speed on mainline curves more closely matching the design speed on adjoining sections of the I-70 highway. Locations include:

- West of Wolcott (milepost 155 to milepost 156)
- Dowd Canyon (milepost 170 to milepost 173)
- Fall River Road (milepost 237 to milepost 238)
- East of the Twin Tunnels (milepost 242 to milepost 245)

Other Improvements

- Black Gore Creek, Straight Creek, and Clear Creek Sediment Control Action Plans provide better control of runoff from snowmelt and are early action projects.
- Hidden Valley to US 6 Frontage Road (two lanes between milepost 243 and milepost 244) provides a new frontage road to improve emergency and local access.
- Idaho Springs to Hidden Valley Frontage Road improvements include rebuilding or repaving portions of the road to higher design standards to improve emergency and local access.
- Bus Service in Mixed Traffic was eliminated as a standalone alternative but is part of the Minimal Action Alternative to provide a corridorwide transit option where none currently exists. Such a service connects existing operators such as Roaring Fork Transportation Authority, ECO Transit, Summit Stage, and Regional Transportation District.

Table 4 provides an overview of how these minimal action components described above fit in with each of the Action Alternatives.

5.2 Transit Alternatives

Four Transit alternatives were advanced for consideration in the PEIS as a reasonable range representing the Fixed Guideway and Rubber Tire Transit families. Transit alignments could be on either side of the I-70 highway but are typically in median areas. All transit systems connect with the Regional Transportation District network at C-470 (the Jefferson Station) and with local and regional transit services at most stations along the route. The Roaring Fork Transportation Authority, ECO Transit in Vail and Summit Stage are some examples of local transit service providers. The four Transit alternatives listed below each are described in this section.

- Rail with Intermountain Connection Alternative
- Advanced Guideway System Alternative
- Dual-Mode Bus in Guideway Alternative
- Diesel Bus in Guideway Alternative

5.2.1 Rail with Intermountain Connection Alternative

The Rail with Intermountain Connection Alternative would provide rail transit service between the Eagle County Regional Airport and C-470 as shown in **Figure 7**. This Transit alternative combines diesel powered trains running on double-track between the Eagle County Regional Airport and Vail, and electric powered trains on a single-track (with passing sidings) between Vail and C-470. The segment between Vail and the Eagle Count Airport would be constructed within the existing Union Pacific Railroad right-of-way. A new Vail Transportation Center, including new track, would be constructed between Vail and Minturn to complete the connection between the diesel and electric trains.

Between Vail and C-470 the rail would be primarily at-grade running adjacent to the I-70 highway. See **Figure 8**. The tracks would be in the median or elevated where necessary to minimize the footprint or to cross from one side of the I-70 highway to the other. Although the specific technology would be defined in a Tier 2 process, the Rail with Intermountain Connection Alternative assumed use of a commuter-oriented diesel multiple-unit type train between the Eagle County Regional Airport and Vail. An electric multiple-unit vehicle was assumed to run between Vail and C-470. Access from the Denver metropolitan area would be through a transfer station near C-470.

New tunnel bores would be required at the Eisenhower-Johnson Memorial Tunnels and the Twin Tunnels. The proposed third tunnel bore for the Eisenhower-Johnson Memorial Tunnels would be located to the north of the existing tunnel bores and would accommodate bidirectional rail as illustrated in **Figure 8**. The tunnel would be approximately 14,500 feet long. The existing north and south bores would continue to operate as they do today with general traffic. **Figure 9** also illustrates the proposed third tunnel bore for the Twin Tunnels, which would be located south of the existing tunnel bores and would accommodate bidirectional rail. The existing north and south bores would operate with highway lanes as they do today. The proposed length of the tunnel would be approximately 740 feet. In the Tier 2 process, relocating the Scott Lancaster memorial Bike Path bridge over Clear Creek could be considered to allow the eastbound Twin Tunnel approach on grade, which could reduce tunnel costs.

Between Vail and C-470 the electrified portion of this alternative would include catenary structures and conductors that would provide power to the train. The catenary structures would consist of poles, located every 80 to 100 feet for the entire length of the electrified alignment with a conductor wires strung between poles. Photographs of existing EMU systems with catenary equipment are illustrated in **Figure 10**.

Table 14. Preferred Alternative and the Minimal Action Components Associated with each Build Alternative

					Transit Alternatives				Highway Alternatives		
			1	2	3	4	5	6	7	8	9
			Preferred Alternative - Short Term	Minimal Action Alternative	Rail with IMC	Advanced Guideway System	Dual-Mode Bus in Guideway	Diesel Bus in Guideway	6-Lane Highway 55 mph	6-Lane Highway 65 mph	Reversible/ HOV/HOT Lanes
	Base Cost of Mainline Alternative (Billions)										
	Location	MA Cost* (Millions)									
Minimal Action Components – Interchange	Glenwood Springs (mp 116)										
	Gypsum (mp 140)										
	Eagle & Spur Road (mp 147)										
	Edwards & Spur Road (mp 163)										
	Avon (mp 167)										
	Minturn (mp 171)										
	Vail West (mp 173) / Simba Run										
	Copper Mountain (mp 195)										
	Frisco / Main St. (mp 201)										
	Frisco / SH 9 (mp 203)										
	Silverthorne (mp 205)										
	Loveland Pass (mp 216)										
	Silver Plume (mp 226)										
	Georgetown (mp 228)										
	Empire (mp 232)										
	Downieville (mp 234)										
	Fall River Road (mp 238)										
	Idaho Springs West (mp 239)										
	Idaho Springs / SH 103 (mp 240)										
	Idaho Springs East (mp 241)										
	Base of Floyd Hill / US 6 (mp 244)										
	Hyland Hills / Beaver Brook (mp 247 / mp 248)										
	Lookout Mountain (mp 256)										
	Morrison (mp 259)										
Curve Safety	West of Wolcott (mp 155-156)										
	Dowd Canyon (mp 170-173)									***	
	Fall River Road (mp 237-238)										
	East of Twin Tunnels (mp 242-245)										
Auxiliary Lane	Avon to Post, Uphill (EB) (mp 167-168)										
	West side of Vail Pass, Downhill (WB) (mp 180-190)										
	West side of Vail Pass, Uphill (EB) (mp 180-190)										
	Frisco to Silverthorne (EB) (mp 202.7-205.1) **/****										
	EJMT to Herman Gulch, Downhill (EB) (mp 215-218) ****										
	Bakerville to EJMT, Uphill (WB) (mp 215-221) ****										
	Georgetown to Silver Plume, Uphill (WB) (mp 226-228) ****										
	Silver Plume to Georgetown, Downhill (EB) (mp 226-228) ****										
	Downieville to Empire, Uphill (WB) (mp 232-234)										
	Empire to Downieville, Downhill (EB) (mp 232-234)										
	Black Hawk Tunnel Off-ramp to Hidden Valley Off-ramp (WB) (mp 244-243)										
	Morrison to Chief Hosa, Uphill (WB) (mp 253-259)										
	Transportation Management										
Misc.	Other items in the Corridor										
	Idaho Springs East to Hidden Valley (improve existing frontage road)										
	Buses in Mixed Traffic										
	Corridor Wide Sediment Control										

* Minimal Action components were estimated as a package. Costs may vary if Minimal Action components were estimated to be constructed on a stand-alone basis.
** This is a new auxiliary lane added after the release of the Draft PEIS. See Section 2.5 for details.
**** Costs for these auxiliary lanes have been increased. See Section 2.5 for details.

Alternative includes this Minimal Action component
Alternative does not include this Minimal Action component
Alternative includes this Minimal Action component as part of the Base Cost
*** Tunnel at Dowd Canyon achieves Minimal Action component of curve safety modification

Table 14. Preferred Alternative and the Minimal Action Components Associated with each Build Alternative (continued)

				Combination Transit/Highway Alternatives											
				10			11			12			13		
				6-Lane Highway with Rail and IMC			6-Lane Highway with AGS			6-Lane Highway with Dual-Mode Bus in Guideway			6-Lane Highway with Diesel Bus in Guideway		
				9-Combination Build Simultaneously	*9a-Transit with Highway Preservation*	*9b-Highway with Transit Preservation*	*10-Combination Build Simultaneously*	*10a-Transit with Highway Preservation*	*10b-Highway with Transit Preservation*	*11-Combination Build Simultaneously*	*11a-Transit with Highway Preservation*	*11b-Highway with Transit Preservation*	*12-Combination Build Simultaneously*	*12a-Transit with Highway Preservation*	*12b-Highway with Transit Preservation*
		Base Cost of Mainline Alternative (Billions)													
		Location	MA Cost* (Millions)												
Minimal Action Components	Interchange	Glenwood Springs (mp 116)													
		Gypsum (mp 140)													
		Eagle & Spur Road (mp 147)													
		Edwards & Spur Road (mp 163)													
		Avon (mp 167)													
		Minturn (mp 171)													
		Vail West (mp 173) / Simba Run													
		Copper Mountain (mp 195)													
		Frisco / Main St. (mp 201)													
		Frisco / SH 9 (mp 203)													
		Silverthorne (mp 205)													
		Loveland Pass (mp 216)													
		Silver Plume (mp 226)													
		Georgetown (mp 228)													
		Empire (mp 232)													
		Downieville (mp 234)													
		Fall River Road (mp 238)													
		Idaho Springs West (mp 239)													
		Idaho Springs / SH 103 (mp 240)													
		Idaho Springs East (mp 241)													
		Base of Floyd Hill / US 6 (mp 244)													
		Hyland Hills / Beaver Brook (mp 247 / mp 248)													
		Lookout Mountain (mp 256)													
		Morrison (mp 259)													
	Curve Safety	West of Wolcott (mp 155-156)													
		Dowd Canyon (mp 170-173)													
		Fall River Road (mp 237-238)													
		East of Twin Tunnels (mp 242-245)													
	Auxiliary Lane	Avon to Post, Uphill (EB) (mp 167-168)													
		West side of Vail Pass, Downhill (WB) (mp 180-190)													
		West side of Vail Pass, Uphill (EB) (mp 180-190)													
		Frisco to Silverthorne (EB) (mp 202.7-205.1) **/****													
		EJMT to Herman Gulch, Downhill (EB) (mp 215-218) ****													
		Bakerville to EJMT, Uphill (WB) (mp 215-221) ****													
		Georgetown to Silver Plume, Uphill (WB) (mp 226-228) ****													
		Silver Plume to Georgetown, Downhill (EB) (mp 226-228) ****													
		Downieville to Empire, Uphill (WB) (mp 232-234)													
		Empire to Downieville, Downhill (EB) (mp 232-234)													
		Black Hawk Tunnel Off-ramp to Hidden Valley Off-ramp (WB) (mp 244-243)													
		Morrison to Chief Hosa, Uphill (WB) (mp 253-259)													
		Transportation Management													
	Misc.	Other items in the Corridor													
		Idaho Springs East to Hidden Valley (improve existing frontage road)													
		Buses in Mixed Traffic													
		Corridor Wide Sediment Control													

* Minimal Action components were estimated as a package. Costs may vary if Minimal Action components were estimated to be constructed on a stand-alone basis.
** This is a new auxiliary lane added after the release of the Draft PEIS. See Section 2.5 for details.
**** Costs for these auxiliary lanes have been increased. See Section 2.5 for details.

Legend:
- Alternative includes this Minimal Action component
- Alternative does not include this Minimal Action component
- Alternative includes this Minimal Action component as part of the Base Cost
- *** Tunnel at Dowd Canyon achieves Minimal Action component of curve safety modification

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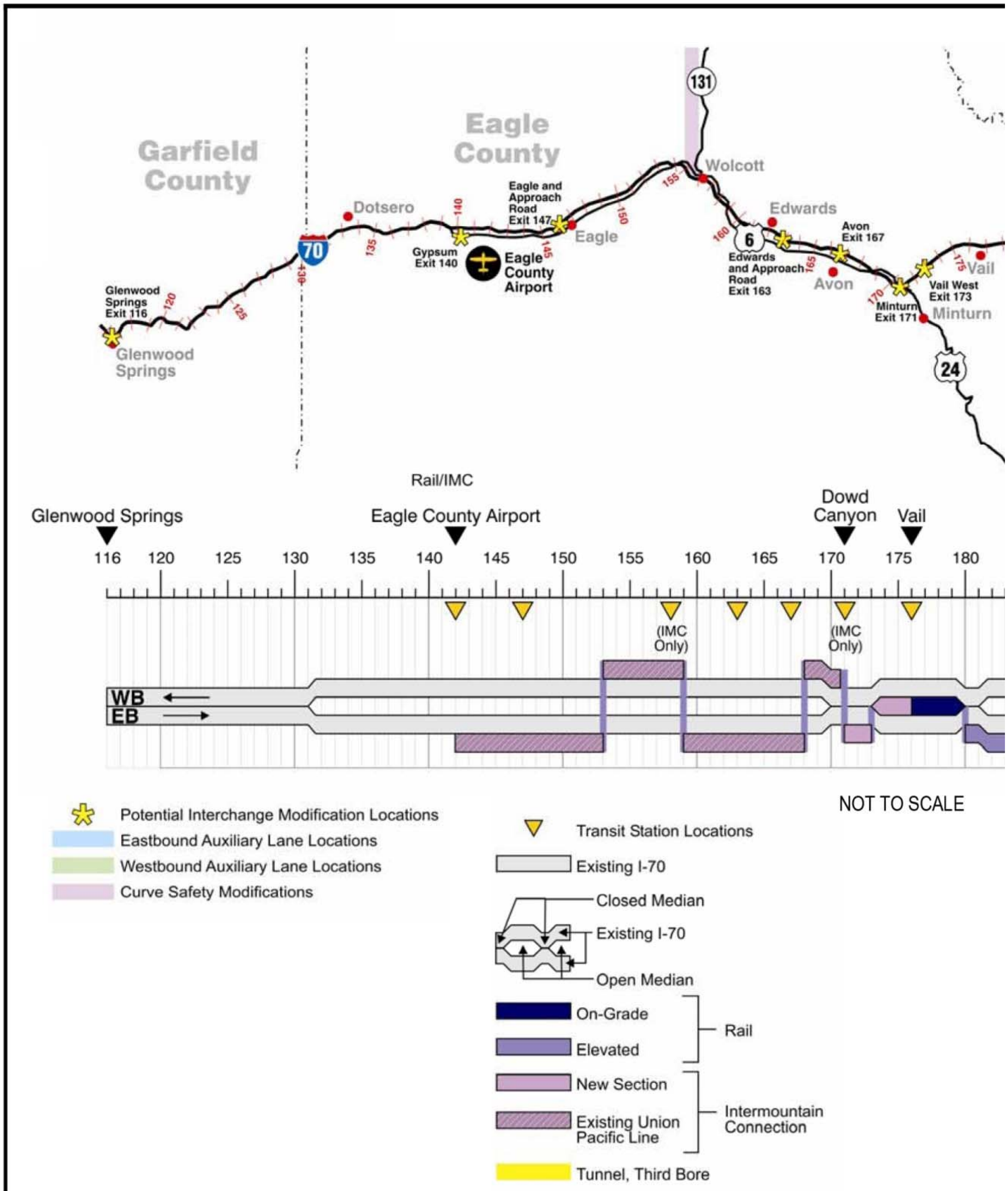
Figure 7. Rail with IMC Alternate Overview



Notes:

1) Placement of colored bars indicates whether that portion of the altnernative would be on the north or south side or in the median of existing I-70.
2) Selected localized safety and capacity improvement components of Minimal Action are assumed to be included in each of the action alternatives (interchange modifications, auxilliary lanes, curve safety modifications)

Figure 7. Rail with IMC Alternate Overview (Continued)

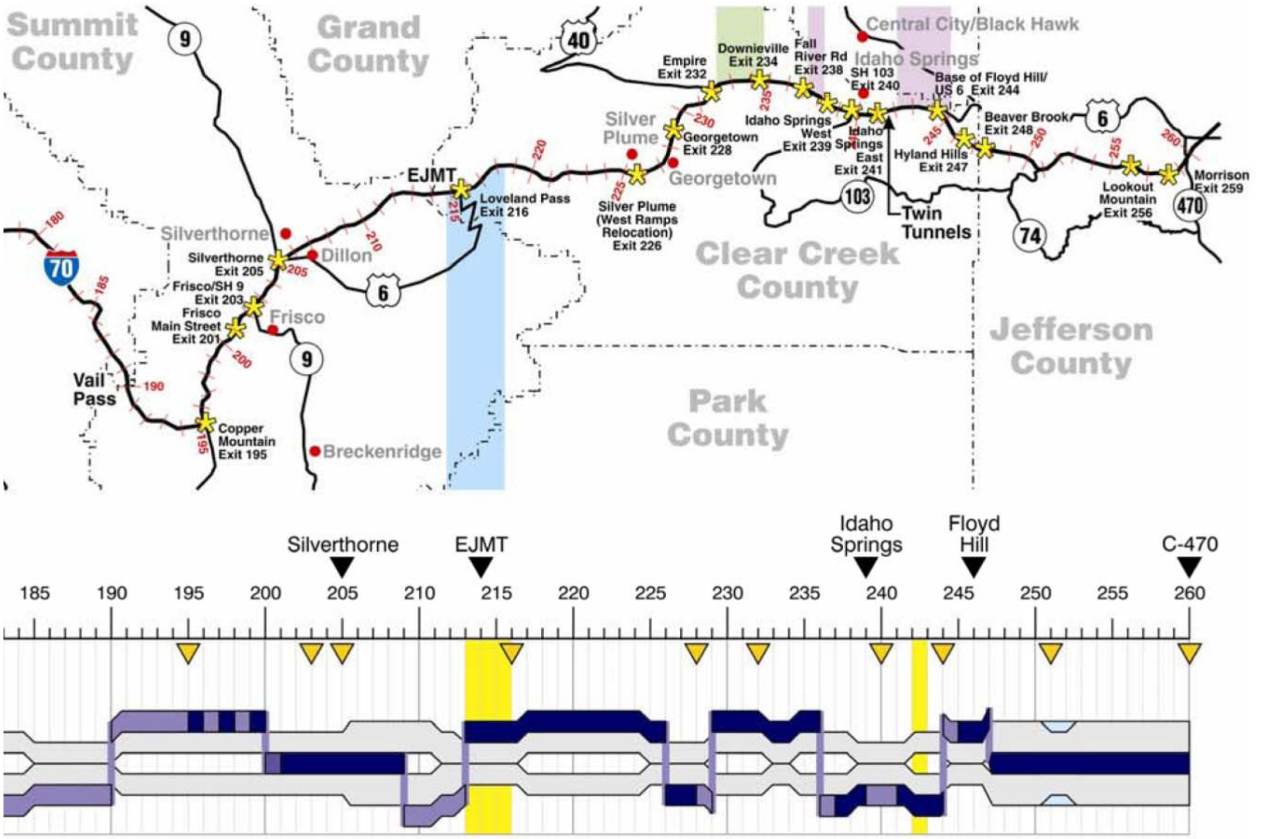
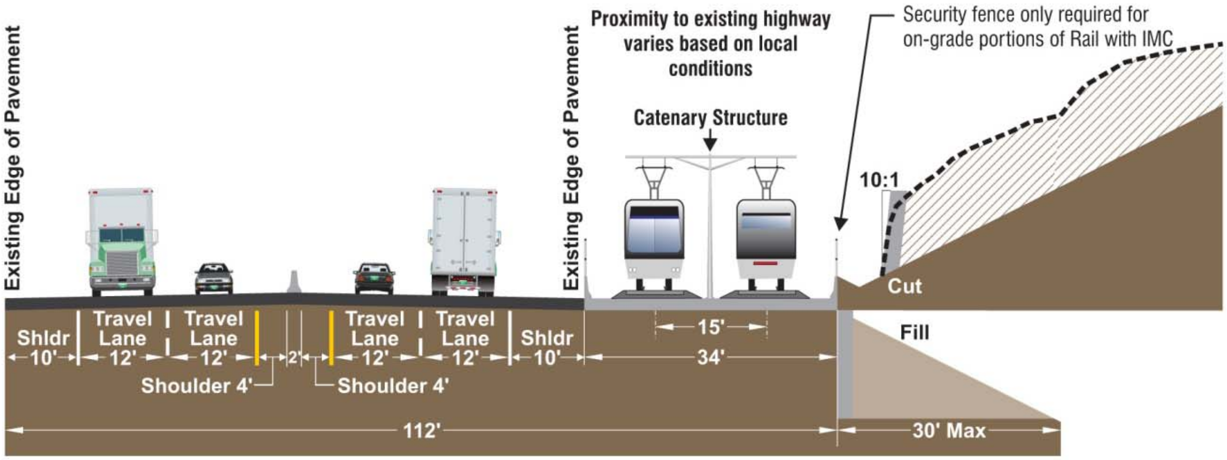
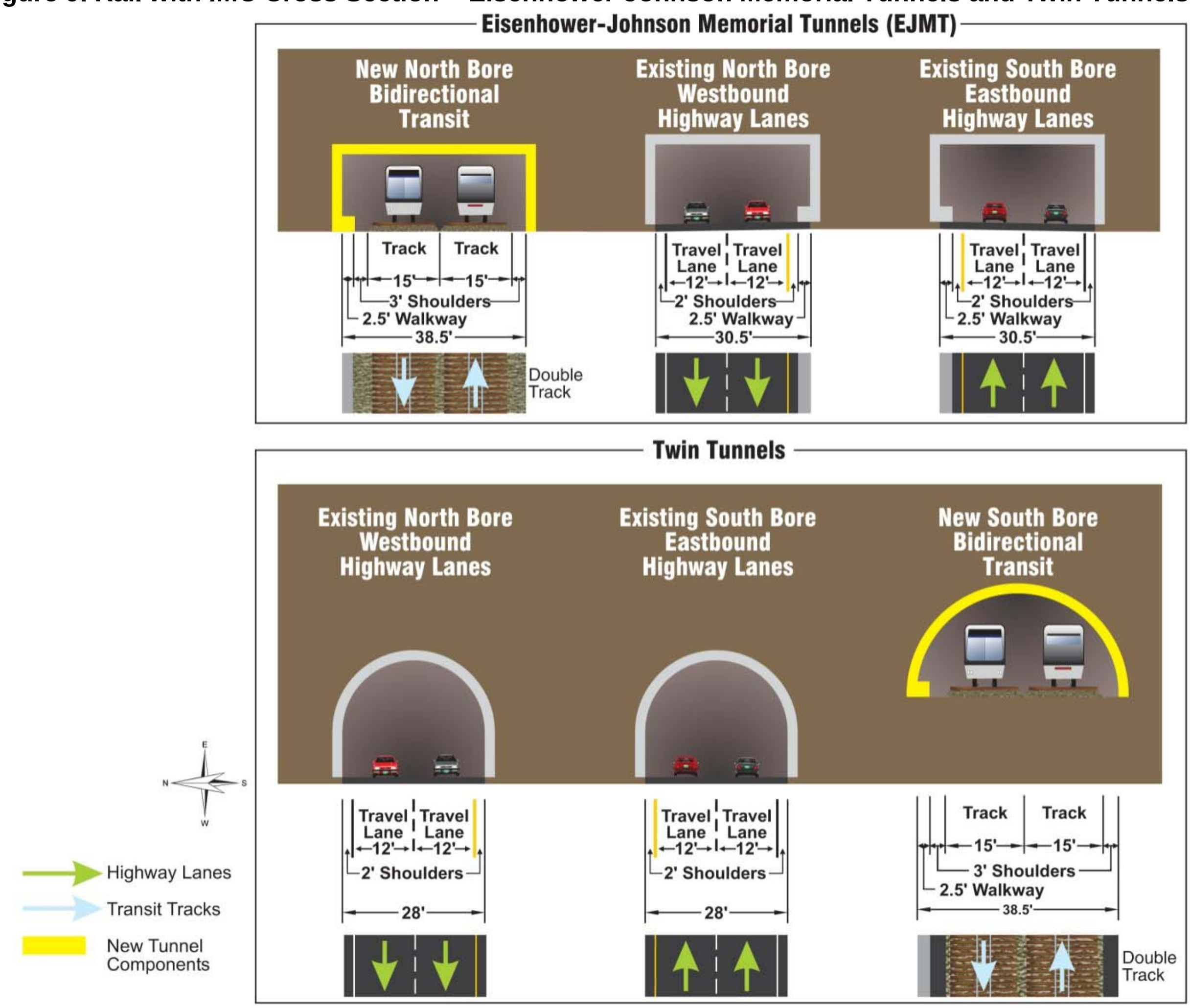


Figure 8. Rail with IMC Cross Section – Typical Configuration



Note: All illustrations view from west to east.

Figure 9. Rail with IMC Cross Section – Eisenhower-Johnson Memorial Tunnels and Twin Tunnels

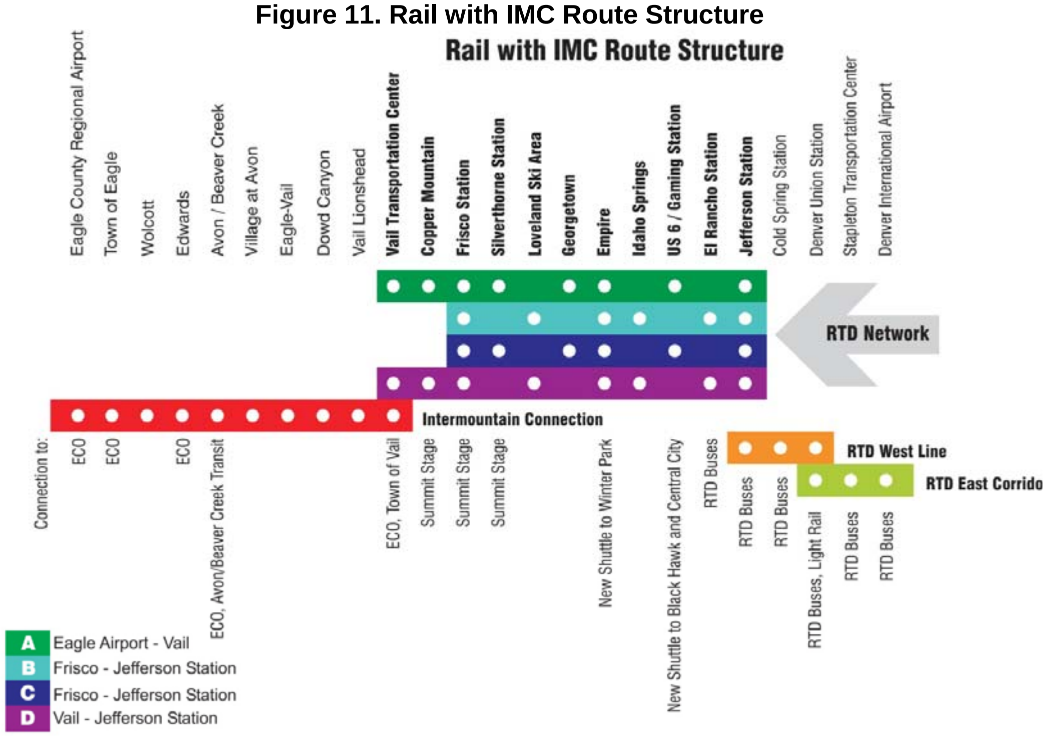


Note: All illustrations view from west to east.

Figure 10. Electric Multiple Unit Vehicles with Catenary

The Vail to C-470 line would operate “skip-stop” service, also known as “express service,” during periods of high demand to allow for faster long-distance trips. A local train making all stops would run at night and during other periods of lower demand. **Figure 11** shows and describes more details regarding the route structure and service. To reach off-Corridor destinations, passengers would transfer to existing transit or shuttle service providers.

Figure 11. Rail with IMC Route Structure



The route structure map follows a convention used by many transit operators, including Breckenridge Free Ride, Copper Mountain Resort, Keystone Resort, RTD, Summit Stage, and Town of Vail Transit. Each route is shown by a uniquely colored line. Stops served by a route are indicated by a white circle (for this map) or other symbol.

The IMC is shown as the red route at the lower left corner of the map. The IMC has a single local route, stopping at all the stations shown.

The Rail system would use four “skip-stop” routes to provide faster long-distance travel in the Corridor and to better match predicted demand levels. All four routes would always stop at Frisco Station, Empire Junction, and Jefferson Station. At other places along the Corridor, the train may serve one station and then skip the following station. For example, the A train would stop at Silverthorne Station, skip the Loveland Ski Area station, and then stop at Georgetown.

The A and C trains would have the same stop pattern between Frisco Station and Jefferson Station; the difference would be that the A train would continue west to Vail Transportation Center. Similarly, the B and D trains would have the same stop pattern, with the B train being “short-turned” at Frisco instead of continuing to Vail as the D train does.

As an example trip, someone traveling from Eagle-Vail to the Gaming Area would first take the IMC to Vail Transportation Center, change to an A train, then get off at the US 6/Gaming station to board a shuttle bus to the casinos. An El Rancho resident traveling to a second home in Silverthorne could first take a B or D train to Empire Junction and then change to an A or C train to complete the journey. If a snowboarder at Copper Mountain wanting to return home to Idaho Springs just missed the D train, she might find it faster to board an A train, and then change to a B train at Frisco or Empire Junction, rather than waiting for the next D train.

At night, the four routes would be replaced by a single route that would stop at every station from Vail to Jefferson.

5.2.2 Advanced Guideway System Alternative

The Advanced Guideway System Alternative would provide transit service between the Eagle County Regional Airport and C-470 with a 24-foot-wide, 118 mile, fully elevated system. The Advanced Guideway System Alternative would use a new technology that provides higher speeds than the other Fixed Guideway Transit technologies studied for the PEIS (**Figure 12**). Technologies such as monorail and magnetic levitation (maglev) transit systems were considered. For the purpose of analysis, the PEIS assumes the Federal Transit Administration urban maglev system. Any Advanced Guideway System would require additional research and review before it could be implemented in the Corridor. The actual technology would be developed in a Tier 2 process.

The Advanced Guideway System guideway would be located north, south, and sometimes within the median of the I-70 highway. The total transportation facility width, including the 24-foot wide elevated guideway and the I-70 highway, would be approximately 93 feet (**Figure 13**). In locations where the median provides adequate width for the Advanced Guideway System structure, the overall width of the I-70 highway would not change from today. The system would include a tubular guideway deck with supporting piers spaced every 80 to 100 feet and a lattice structure underneath the guideway deck along the entire length of the Advanced Guideway System.

The Advanced Guideway System Alternative would require third tunnel bores at the existing Eisenhower-Johnson Memorial Tunnels and Twin Tunnels. As shown in **Figure 14**, the proposed third tunnel bore at the Eisenhower-Johnson Memorial Tunnels would be located north of the existing tunnel bores and would accommodate a bidirectional Advanced Guideway System. The proposed length of the tunnel would be approximately 14,500 feet. The existing north and south bores would remain, and vehicle travel through the existing tunnels would continue as it does today. Similar to the Eisenhower-Johnson Memorial Tunnels, the Twin Tunnels would require an additional bore. An approximately 740–foot-long third tunnel bore, which also allows a bidirectional Advanced Guideway System, would be located south of the existing two bores. **Figure 14** illustrates the location of the new Twin Tunnels bore. **Figure 15** shows what a typical train would looks like as it moves along its guideway.

The Scott Lancaster Memorial Bike Path bridge over Clear Creek would be impacted if the tunnel bore were not elevated. In the Tier 2 process, options for this tunnel approach could consider relocating the trail and keeping the eastbound tunnel approach on grade, which would reduce tunnel costs or review other construction alternatives to avoid the trail.

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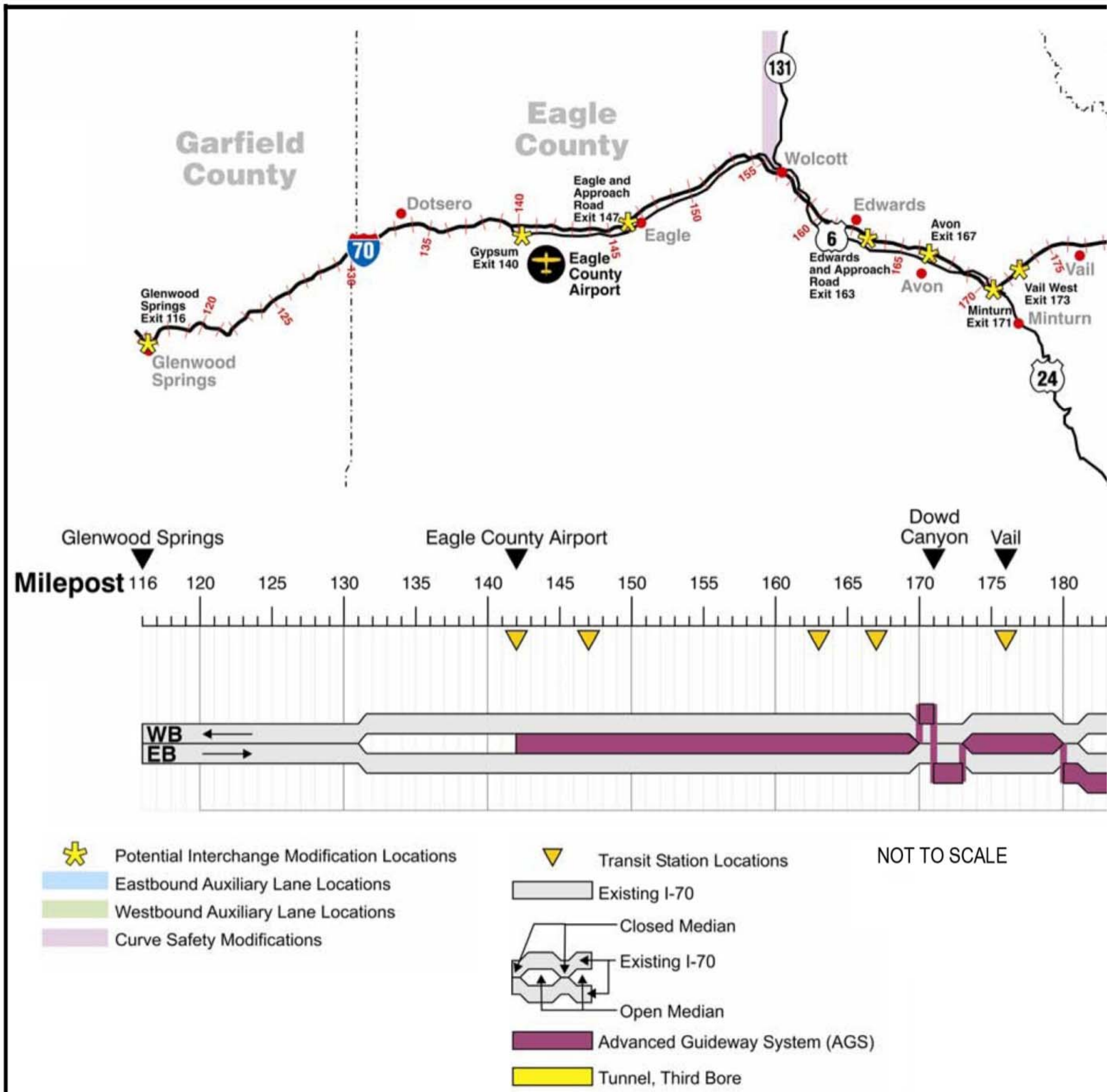
Figure 12. Advanced Guideway System Alternative Overview



Notes:
1) Placement of colored bars indicates whether that portion of the altnernative would be on the north or south side or in the median of existing I-70.
2) Selected localized safety and capacity improvement components of Minimal Action are assumed to be included in each of the action alternatives (interchange modifications, auxilliary lanes, curve safety modifications)

Figure 12. Advanced Guideway System Alternative Overview (Continued)

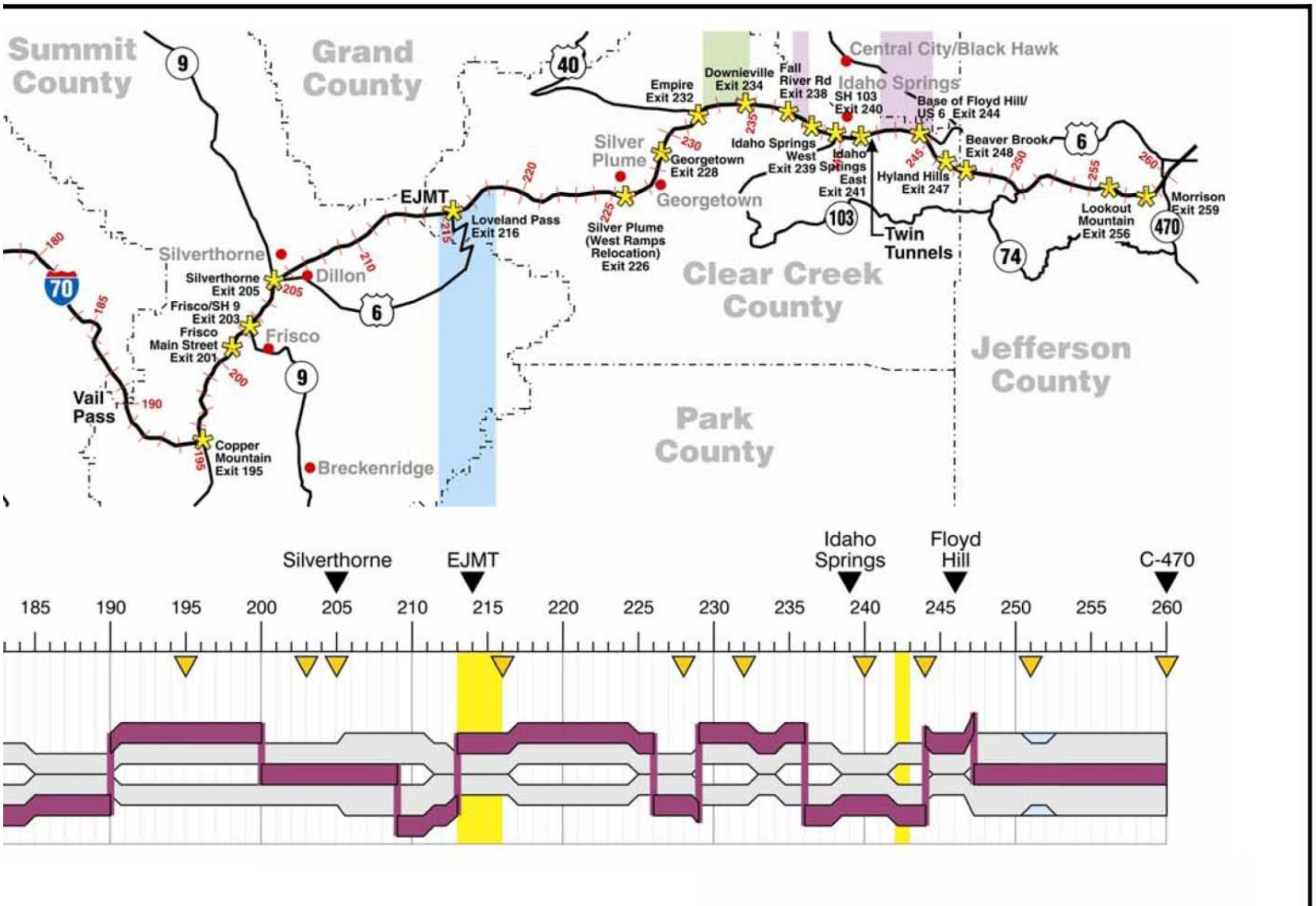
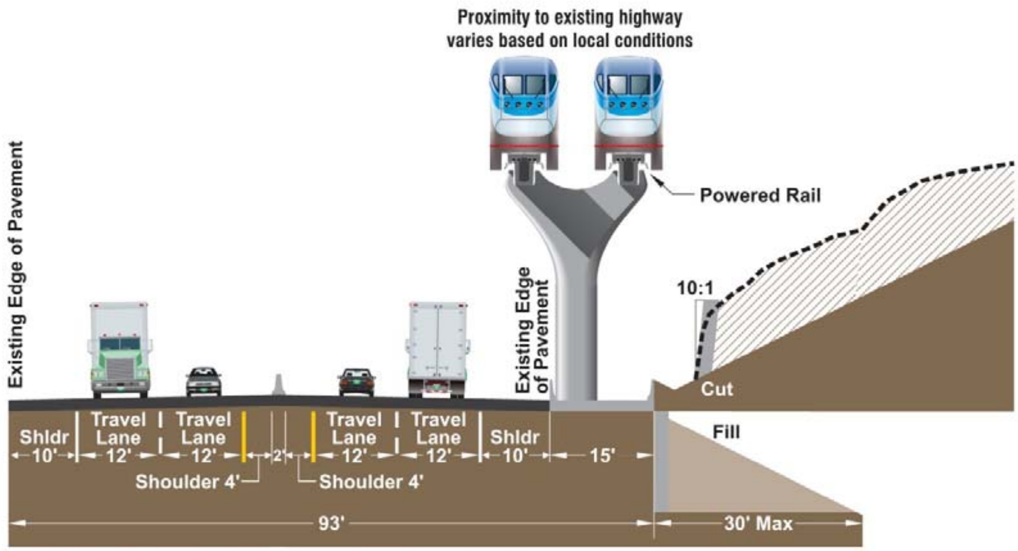
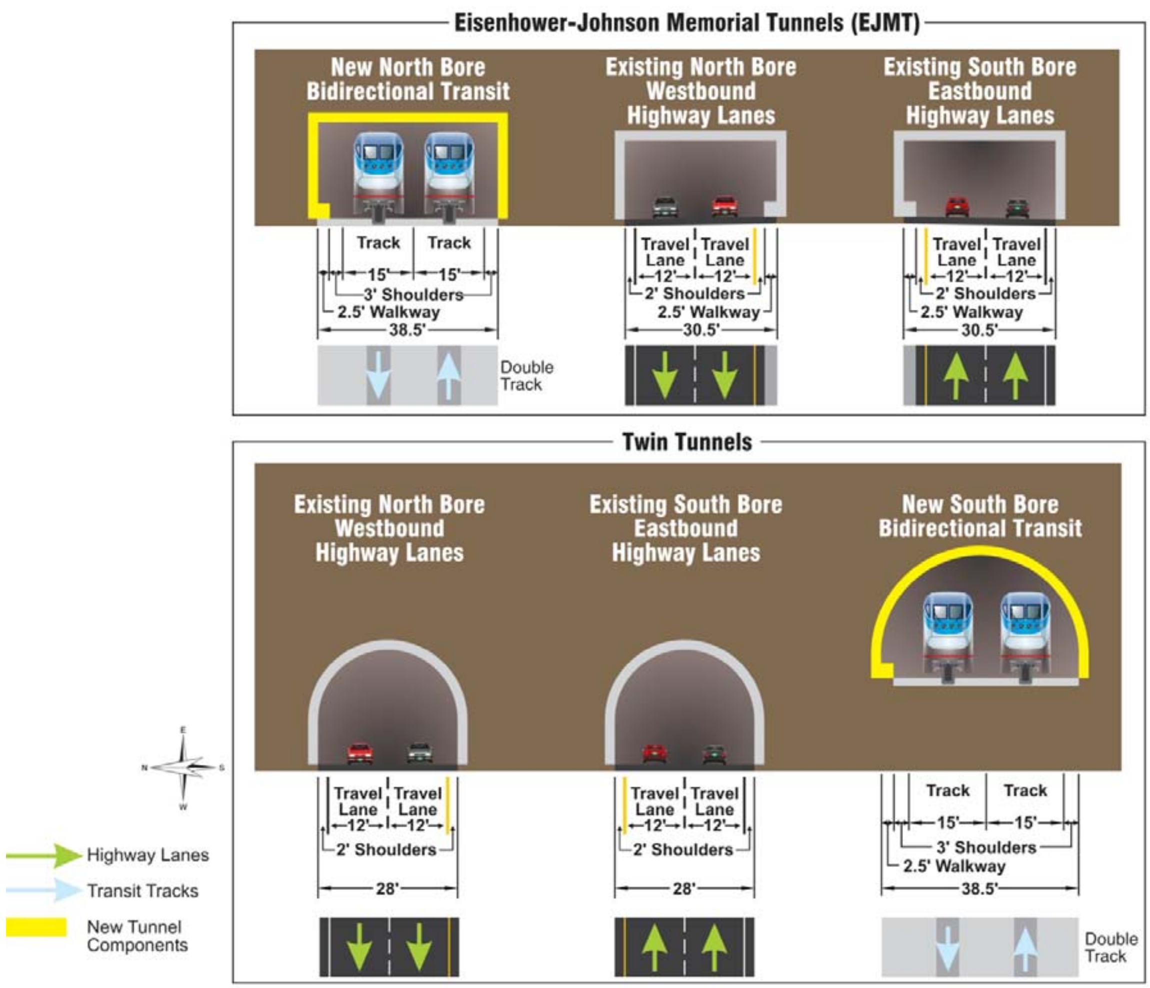


Figure 13. Advanced Guideway System Typical Configuration



Note: All illustrations view from west to east.

Figure 14. Advanced Guideway System Eisenhower-Johnson Memorial Tunnels and Twin Tunnels



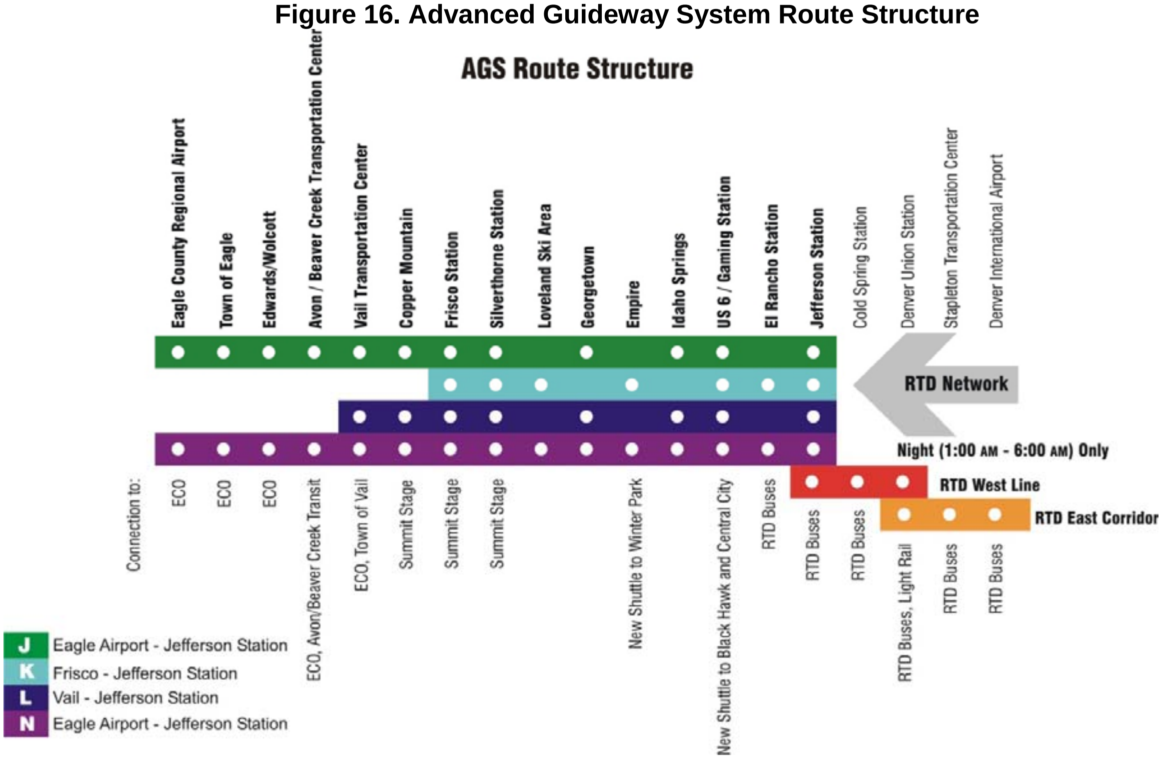
Note: All illustrations view from west to east.

Figure 15. Advanced Guideway System Train

Operating characteristics of the Advanced Guideway System would be based on a set of performance standards and would draw heavily from the work done by the teams of the Maglev Transit Group, Sandia National Laboratories in New Mexico, the Colorado Department of Transportation, and the Colorado Intermountain Fixed Guideway Authority. Like traditional passenger rail, the Advanced Guideway System would use skip-stop operations. All trains would stop at Frisco, Silverthorne, US6/Gaming, and Jefferson stations. Local trains making all stops would run at night and other periods of low demand. The Advanced Guideway System would use two tracks and offer direct services between the Eagle County Airport and C-470. Because of this, the Intermountain Connection, described in the Rail with Intermountain Connection Alternative, would not be included in this alternative. See **Figure 16** for more information regarding the route structure and service.

Upon arrival to Advanced Guideway System stations, passengers would transfer to connecting transit or shuttle services to reach destinations not located on I-70 highway (i.e. Breckenridge, Keystone, etc.). To reach off-I-70 highway destinations, passengers would transfer to existing transit or shuttle service providers.

Figure 16. Advanced Guideway System Route Structure



5.2.3 Dual-mode Bus in Guideway Alternative

A guideway for the Dual-Mode Alternative would be located in the I-70 highway median with dual-mode buses providing transit service between the Eagle County Regional Airport and C-470 (**Figure 17**). This guideway would be 24 feet wide with 3 feet high guiding barriers and would accommodate bidirectional travel. The barriers direct the movement of the bus and separate the guideway from general purpose traffic lanes. While traveling in the guideway, buses would use guidewheels to provide steering control, thus permitting a narrow guideway and providing safer operations (**Figure 18**). The dual-mode buses would use electric power from a “third rail” in the guideway while moving inside the guideway and use diesel power when operating outside the guideway. There are emerging power technologies such as the fuel cell and compressed natural gas which have the potential in the future to provide buses with sufficient acceleration for the grades in the I-70 Mountain Corridor. The specific bus technology and guideway alignment would be determined in the Tier 2 process.

In cross sections shown in **Figure 19** an elevated structure is being considered in Idaho Springs to minimize the highway footprint impacts to the community. The elevated configuration would include eastbound traffic lanes stacked above the bidirectional bus guideway. At all other locations along this alignment, the typical configuration shows the guideway in the inside shoulder of the I-70 highway. The existing I-70 highway would need to be widened to the outside in places where the existing median would not accommodate the guideway in the existing space. The total transportation corridor width, including the I-70 highway, ranges from 82 to 100 feet.

New tunnel bores would be required at the Eisenhower-Johnson Memorial Tunnels and the Twin Tunnels. As illustrated **in Figure 20**, the proposed third tunnel bore at the Eisenhower-Johnson Memorial Tunnels would be located north of the existing tunnel bores and would accommodate two lanes of westbound traffic. The proposed length of the tunnel would be approximately 13,700 feet. The existing north bore would accommodate bidirectional buses in a guideway and the existing south bore continues to function as a two lane facility for eastbound vehicles. Also shown in **Figure 10** Dual-Mode, the existing north bore would accommodate two lanes of westbound traffic. The existing south bore would now be the location where buses run in a bidirectional guideway. A new third tunnel bore at the Twin Tunnels would provide two lanes for eastbound traffic.

The Scott Lancaster Memorial Bike Path bridge over Clear Creek would be impacted if the tunnel bore were not elevated. In the Tier 2 process, options for this tunnel approach could consider relocating the trail and keeping the eastbound tunnel approach on grade, which would reduce tunnel costs.

Since the duel-mode bus can travel inside the guideway or on roads outside the guideway powered by diesel fuel, some routes would not require transfers. As shown in **Figure 21**, passengers could complete their trips at destinations off of the I-70 highway. However, to reach some off-I-70 highway destinations, passengers would transfer to existing transit or shuttle service providers.

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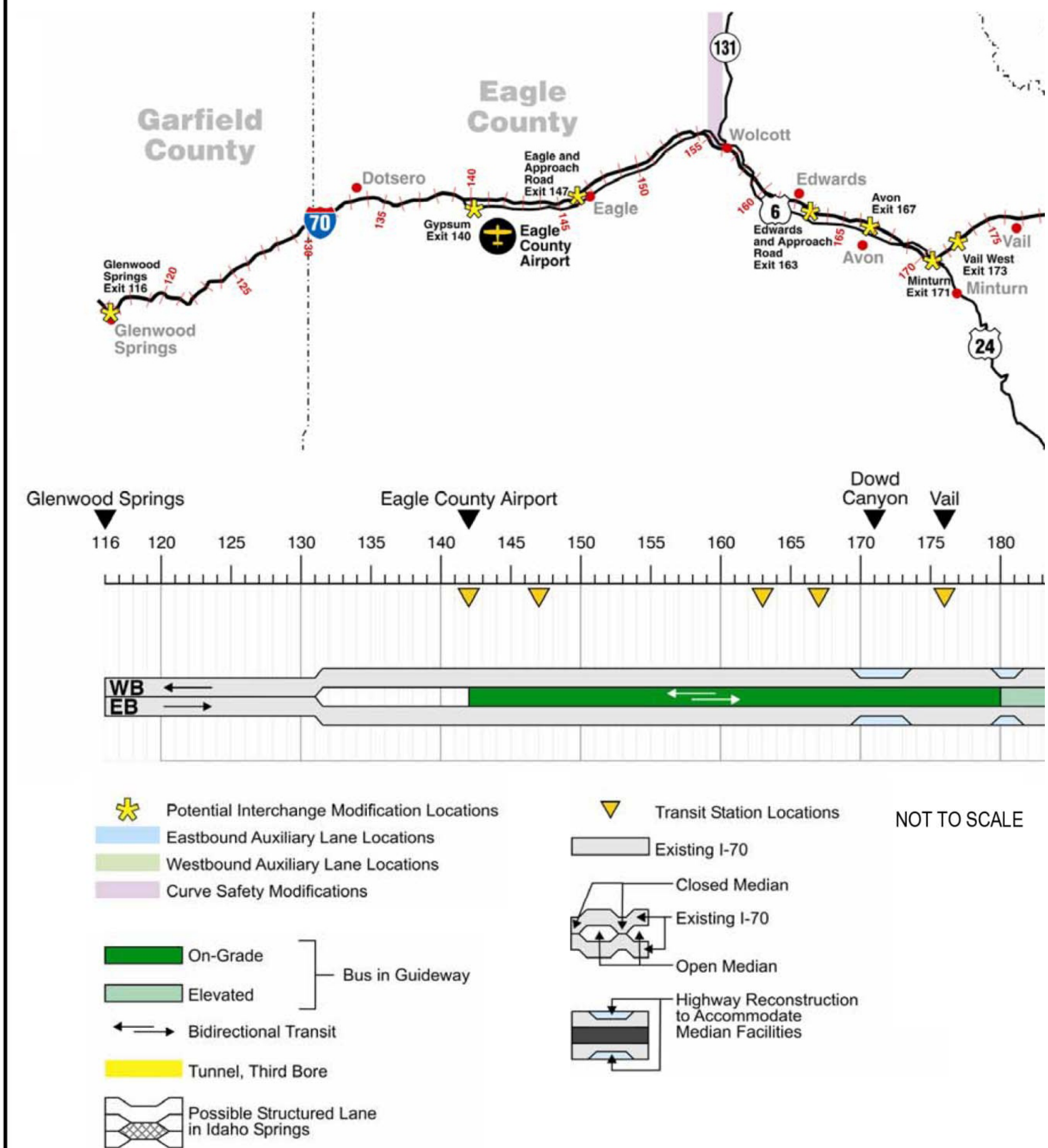
Figure 17. Dual-Mode Bus and Diesel Bus in Guideway Alternative Overview



Notes:
1) Placement of colored bars indicates whether that portion of the altnernative would be on the north or south side or in the median of existing I-70.
2) Selected localized safety and capacity improvement components of Minimal Action are assumed to be included in each of the action alternatives (interchange modifications, auxilliary lanes, curve safety modifications)

Figure 17. Dual-Mode Bus and Diesel Bus in Guideway Alternative Overview (Continued)

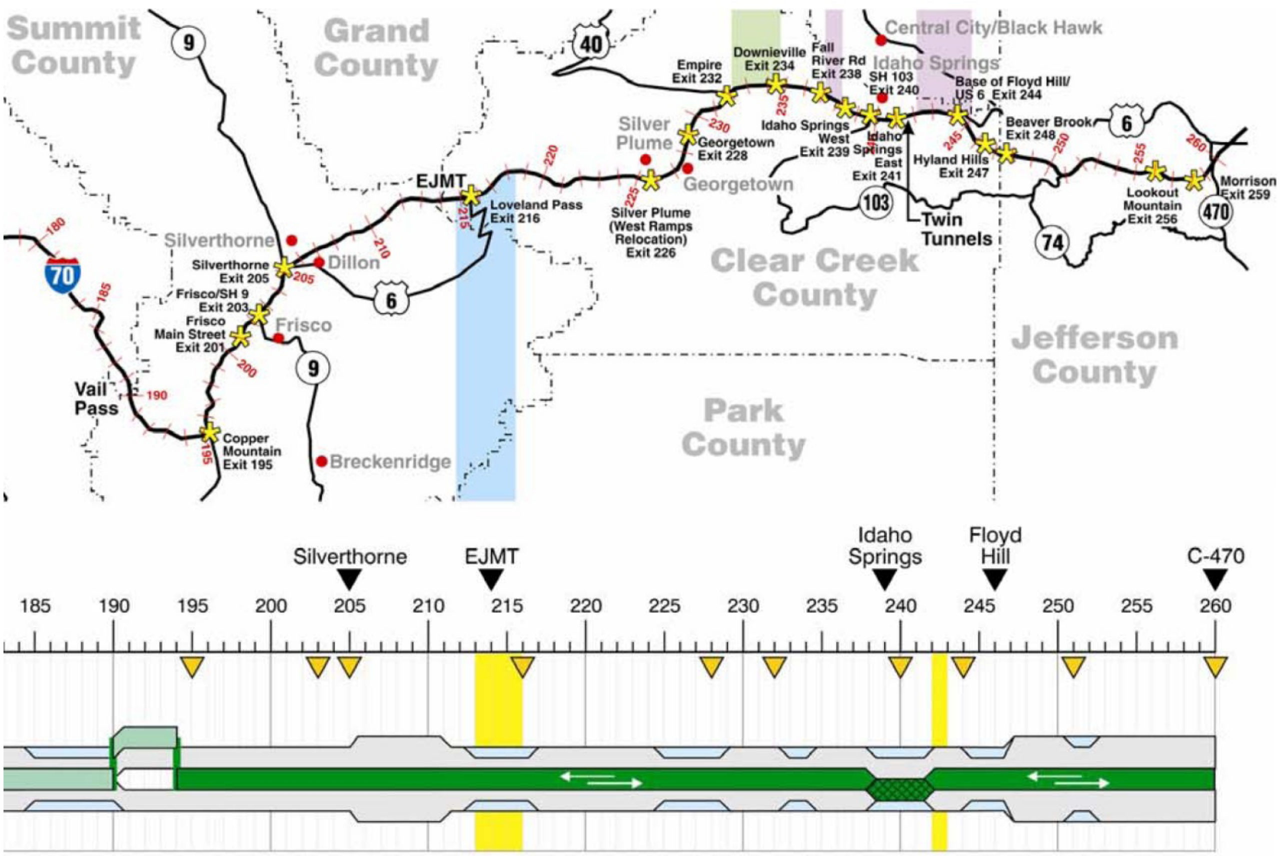


Figure 18. Dual-Mode Bus and Diesel Bus in Guideway Example of Guide Wheels

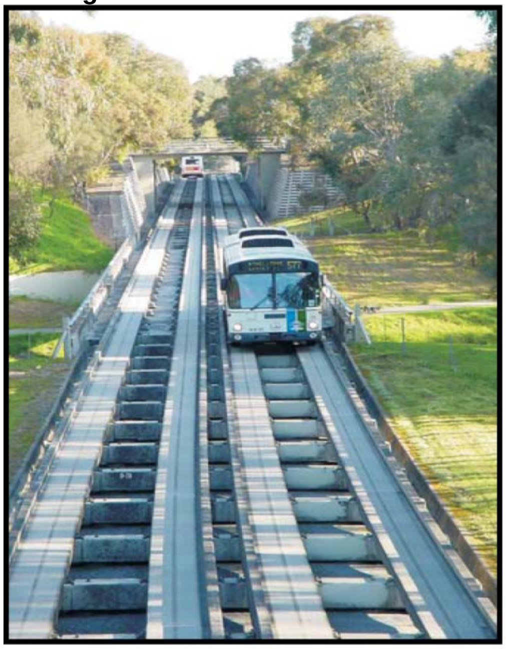
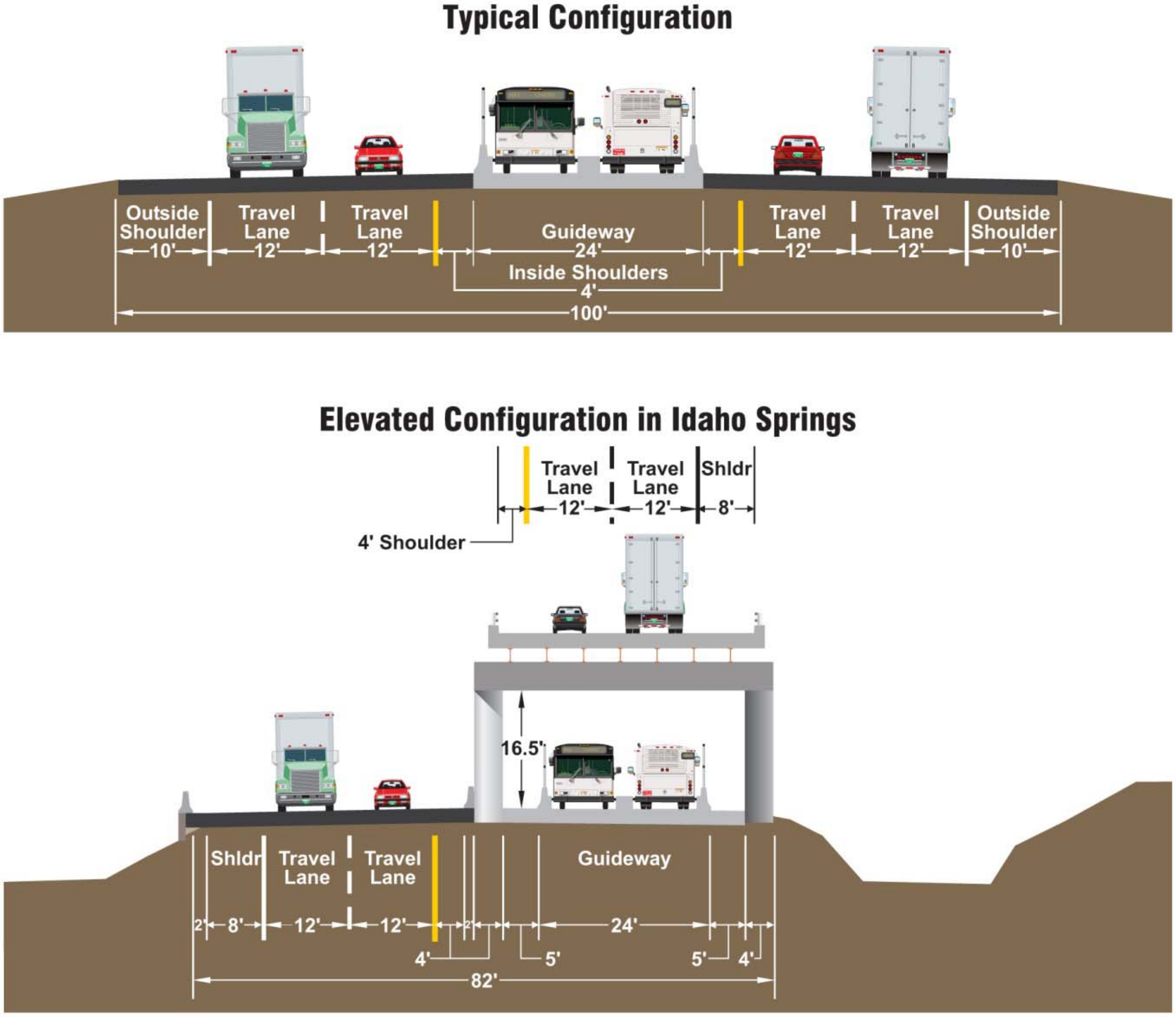
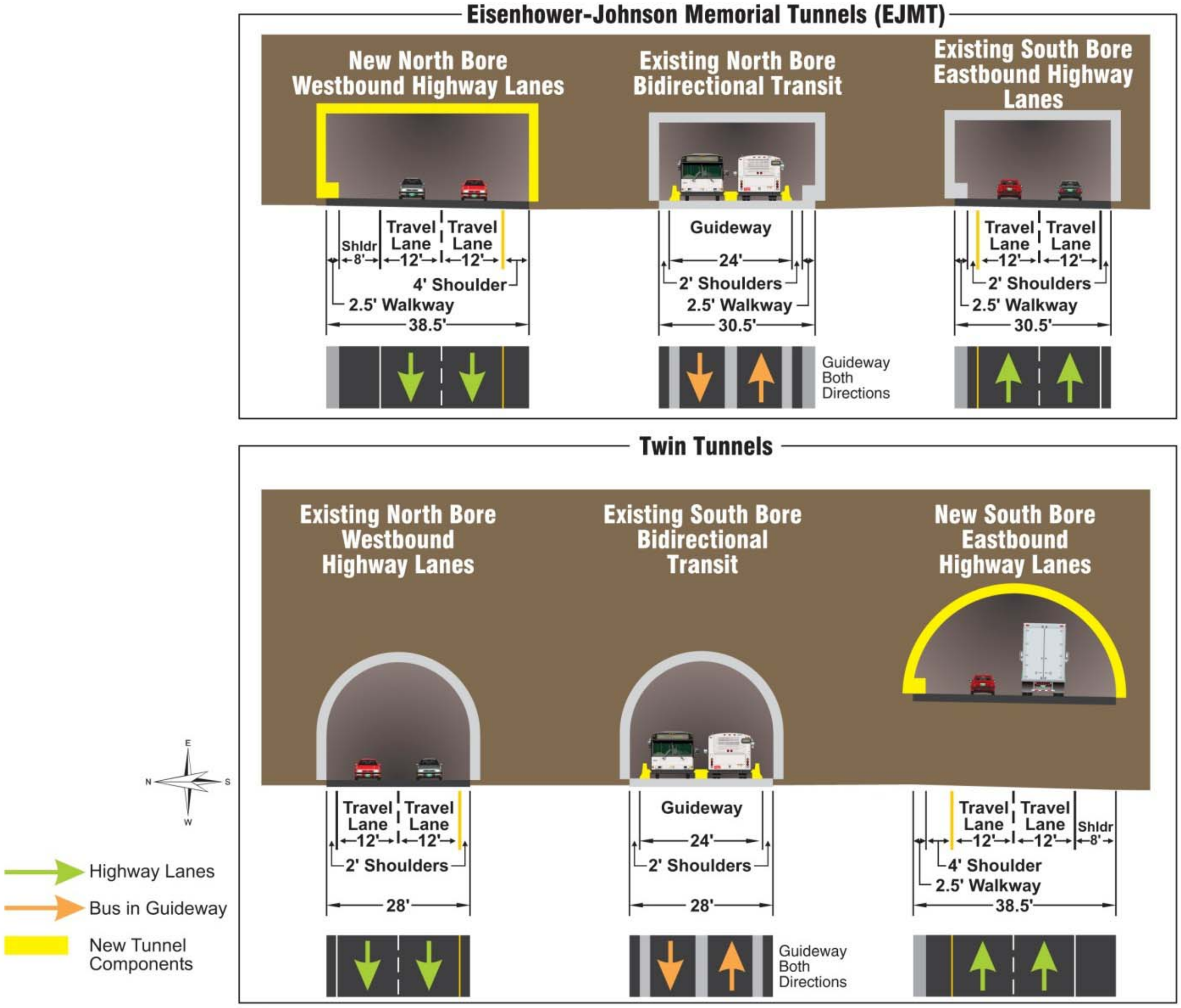


Figure 19. Dual-Mode Bus and Diesel Bus in Guideway Typical Configuration and Elevated Configuration in Idaho Springs



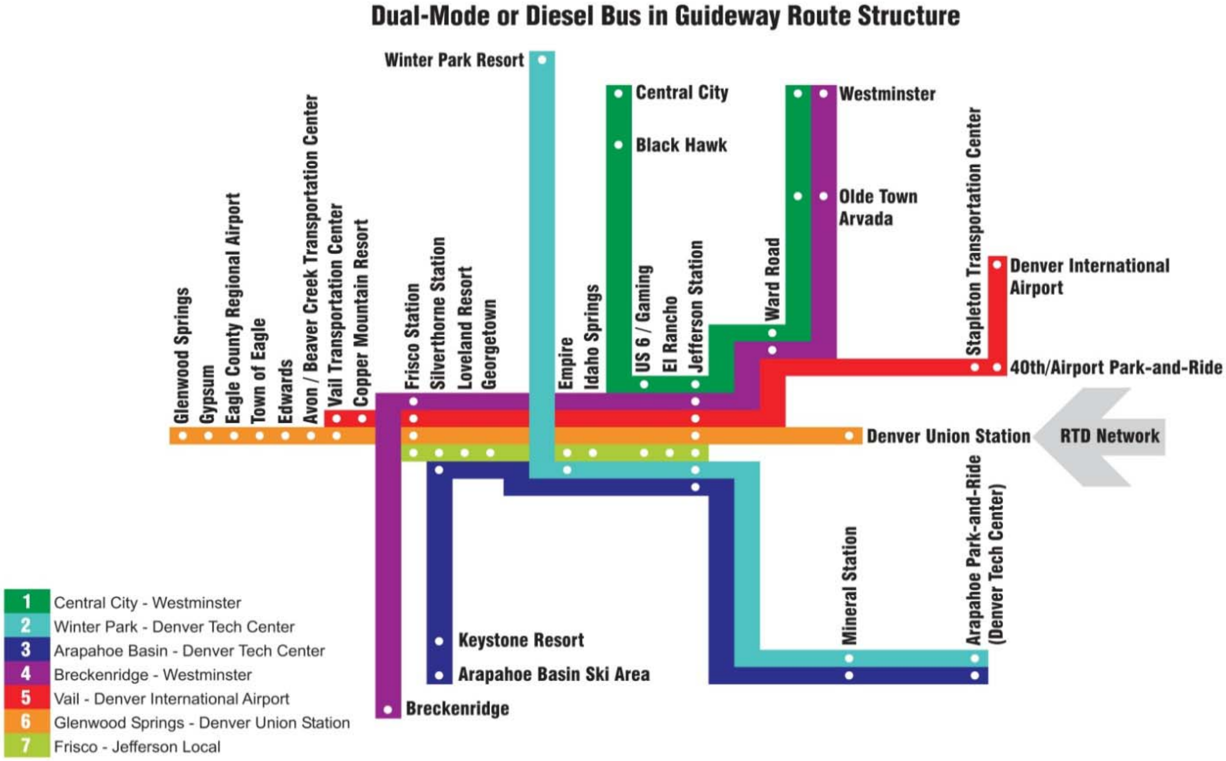
Note: All illustrations view from west to east.

Figure 20. Dual-Mode Bus and Diesel Bus in Guideway Eisenhower-Johnson Memorial Tunnels and Twin Tunnels



Note: All illustrations view from west to east.

Figure 21. Dual-Mode or Diesel Bus in Guideway Route Structure



5.2.4 Diesel Bus in Guideway Alternative

The Diesel Bus in Guideway Alternative is similar to the Dual-Mode Bus in Guideway Alternative. The difference is that instead of dual-mode buses, only diesel powered buses would run in the guideway that is described in the Dual-Mode Bus in Guideway Alternative description and illustrated in **Figure 17** through **15**. The bus would use diesel power at all times which gives it the flexibility to leave the guideway and without passengers having to transfer, serve multiple destinations not on the I-70 highway.

5.3 Highway Alternatives

Three Highway alternatives are advanced for consideration in the PEIS as a reasonable range and representative of the Highway improvements. The highway alternatives are listed below and described in this section.

- Six-Lane Highway 55 mph Alternative
- Six-Lane Highway 65 mph Alternative
- Reversible High Occupancy Vehicle/High Occupancy Toll Lanes Alternative

Both the 55 and 65 mph design speeds are included in the PEIS and retained for further analysis in Tier 2 when more detailed designs are developed and evaluations are conducted. The two design speeds are included to 1) establish corridor consistency and 2) address deficient areas within the Corridor. The 55 mph design speed establishes a consistent design speed throughout the Corridor, which currently doesn’t exist. The 65 mph design speed furthermore improves mobility and addresses safety deficiencies in key locations such as Dowd Canyon and the Twin Tunnels. Both the 55 mph and the 65 mph design speed options are augmented by curve safety improvements, but the 65 mph design speed constructs tunnels in two of the locations: Dowd Canyon and Floyd Hill/Hidden Valley.

5.3.1 Six-Lane Highway 55 mph Alternative

The Six-Lane Highway 55 mph Alternative would include adding traffic lanes in two locations along the I-70 highway as shown in **Figure 22**. This would involve adding two lanes between mileposts 169 and 173, one eastbound and one westbound, through Dowd Canyon. Two lanes would also be added between milepost 231.5 (at the Eisenhower-Johnson Memorial Tunnels) and milepost 247 (Floyd Hill), one eastbound and one westbound. These lanes would primarily be on grade except in Idaho Springs where structured lanes minimize the highway footprint. Structured eastbound lanes may be used in the Idaho Springs area (mileposts 238.9 to 241.4). **Figure 23** illustrates a typical configuration and the concept of a structure configuration in Idaho Springs. The total transportation corridor width would range from 94 to 111 feet.

The Six-Lane Highway 55 mph Alternative would require third tunnel bores at the existing Eisenhower-Johnson Memorial Tunnels and Twin Tunnels locations. As illustrated in **Figure 5-24**, the Eisenhower-Johnson Memorial Tunnels the proposed third tunnel bore would be located to the north of the existing tunnel bores and would accommodate two lanes of westbound traffic. The proposed length of the tunnel would be approximately 13,700 feet. The existing north bore would be changed to accommodate bidirectional travel. The existing south bore would accommodate two lanes of eastbound traffic.

For the Twin Tunnels the existing north bore would maintain existing two lanes of westbound travel. The existing south bore would operate differently than today with only one travel lane passing through for westbound travel. A new third bore would be located south of the existing tunnel bores and would accommodate three lanes of eastbound traffic. The proposed length of the new tunnel bore would be approximately 740 feet.

The Scott Lancaster Memorial Bike Path bridge over Clear Creek would be impacted if the tunnel bore were not elevated. In the Tier 2 process, options for this tunnel approach could consider relocating the trail and keeping the eastbound tunnel approach on grade, which would reduce tunnel costs.

To improve operations of the I-70 highway, snow storage ditches are proposed to be part of the paved shoulders. The width of the snow storage ditches would be determined by the snow accumulation normally seen above 8,000 feet and the need to have a large enough place to clear the snow and let it melt. These snow storage ditches would be designed to also control runoff into sediment basins. The basins would reduce the amount of sand getting to Clear Creek and Straight Creek.

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Figure 22. Six-Lane Highway 55 mph Alternative Overview

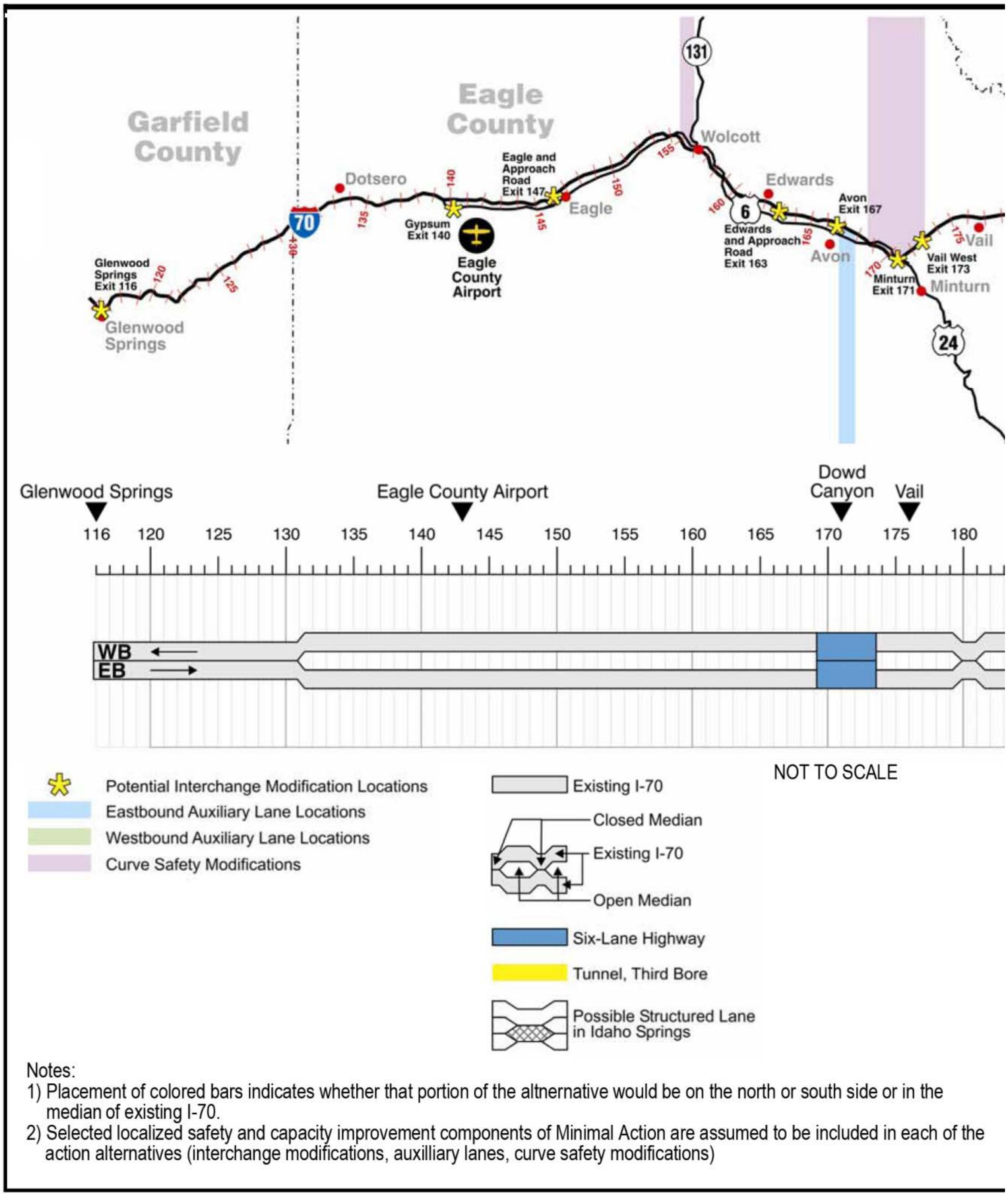


Figure 22. Six-Lane Highway 55 mph Alternative Overview (Continued)

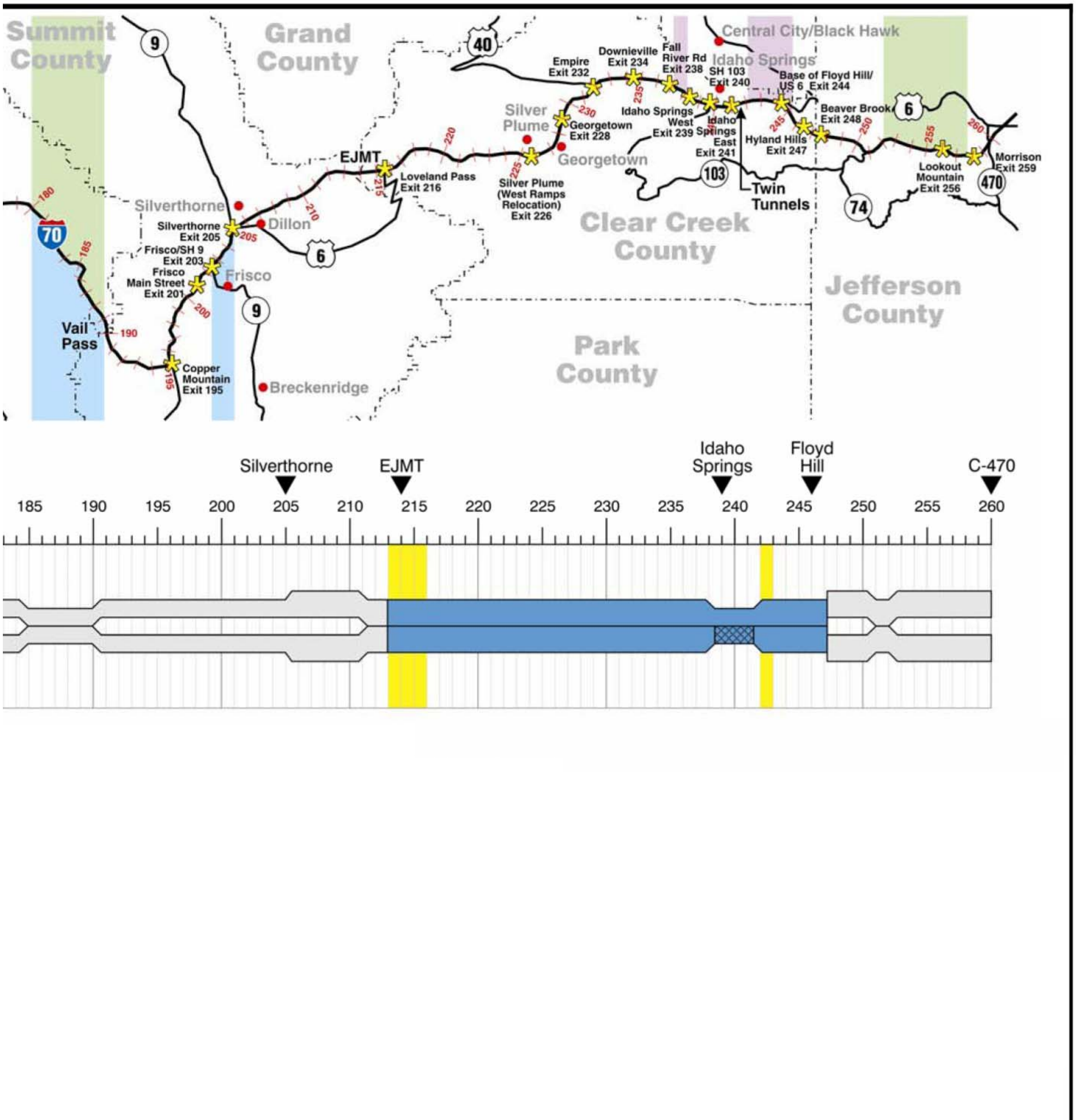
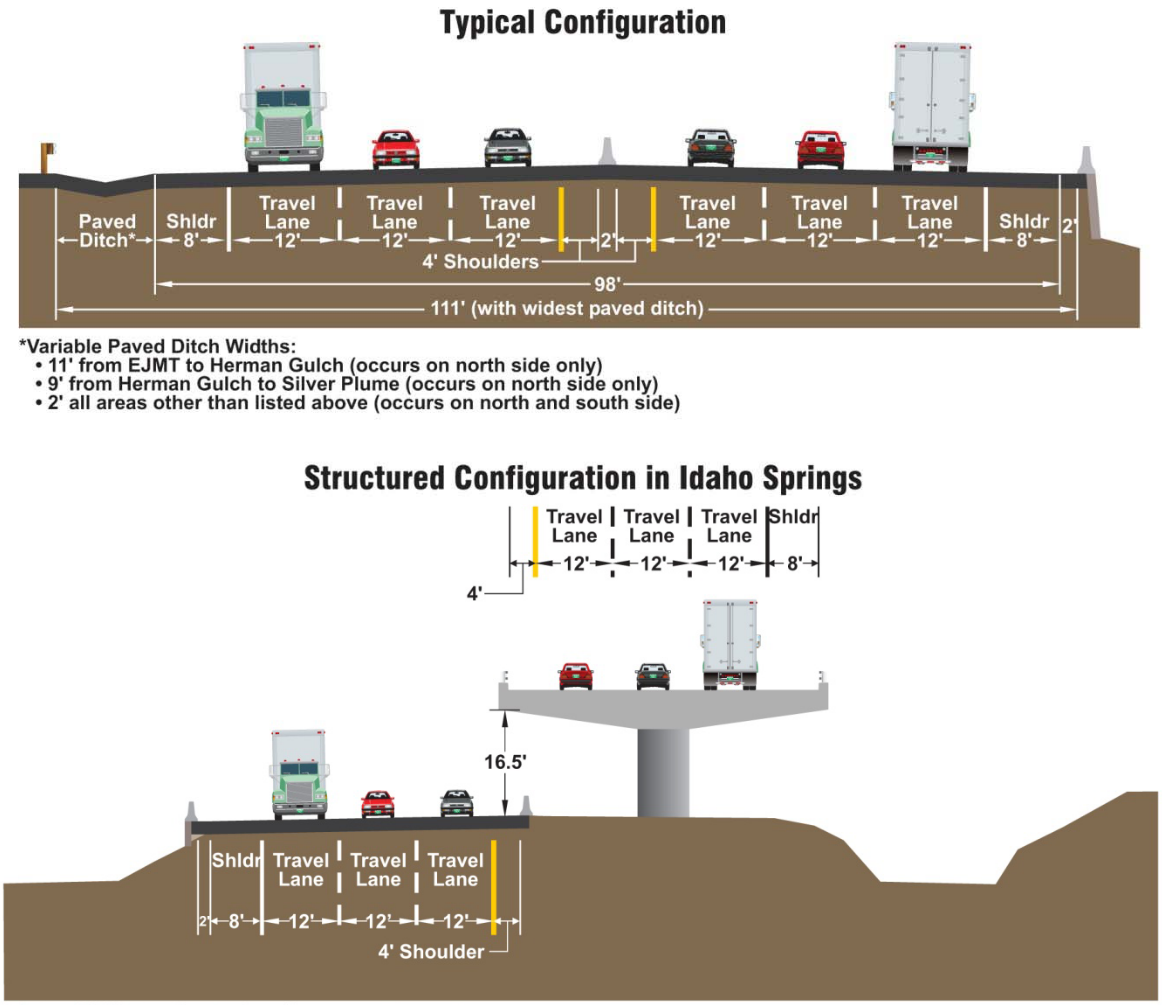
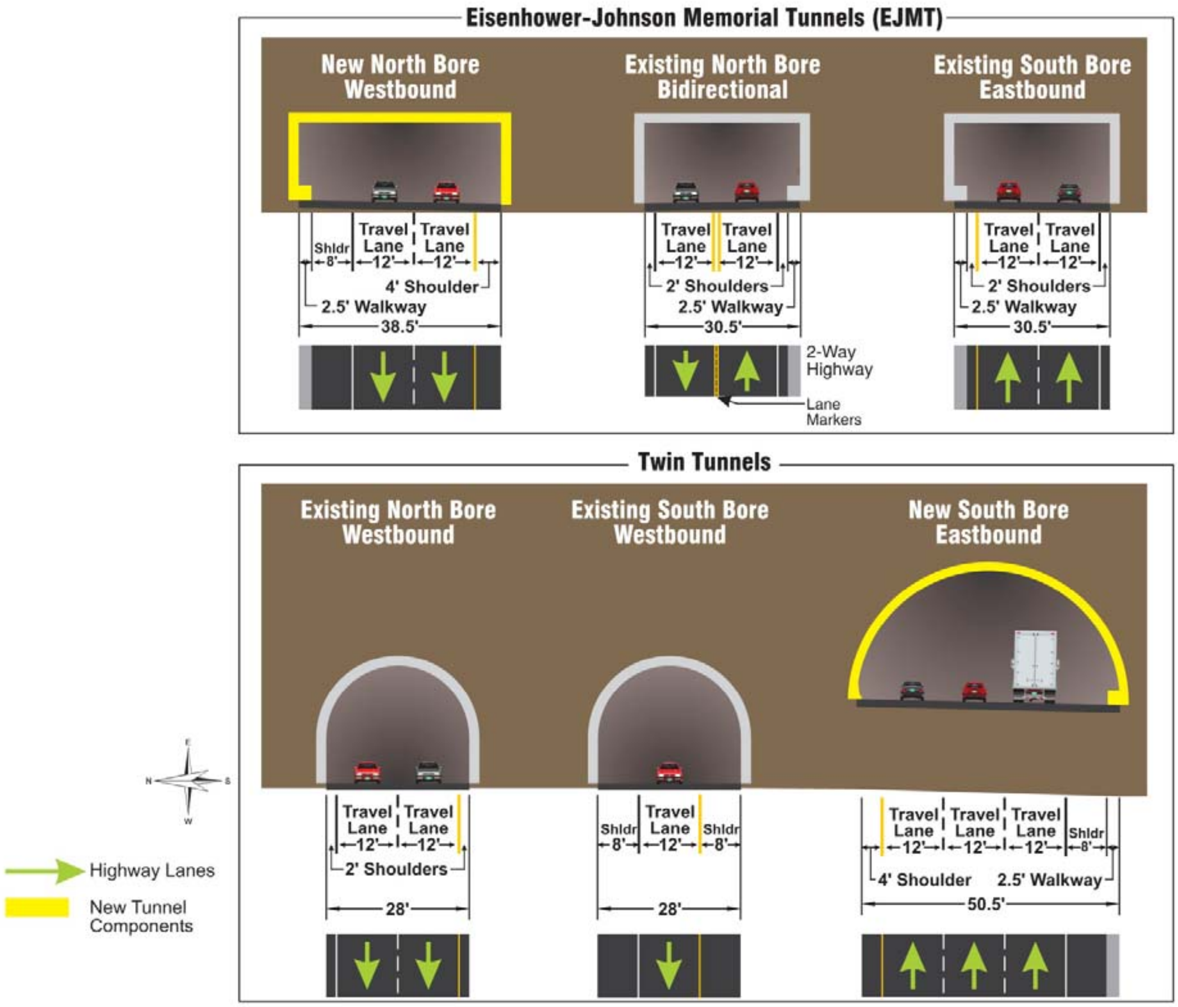


Figure 23. Six-Lane Highway 55 mph Alternative Typical Configuration and Structured Configuration in Idaho Springs



Note: All illustrations view from west to east.

Figure 24. Six-Lane Highway 55 mph Alternative Eisenhower-Johnson Memorial Tunnels and Twin Tunnels



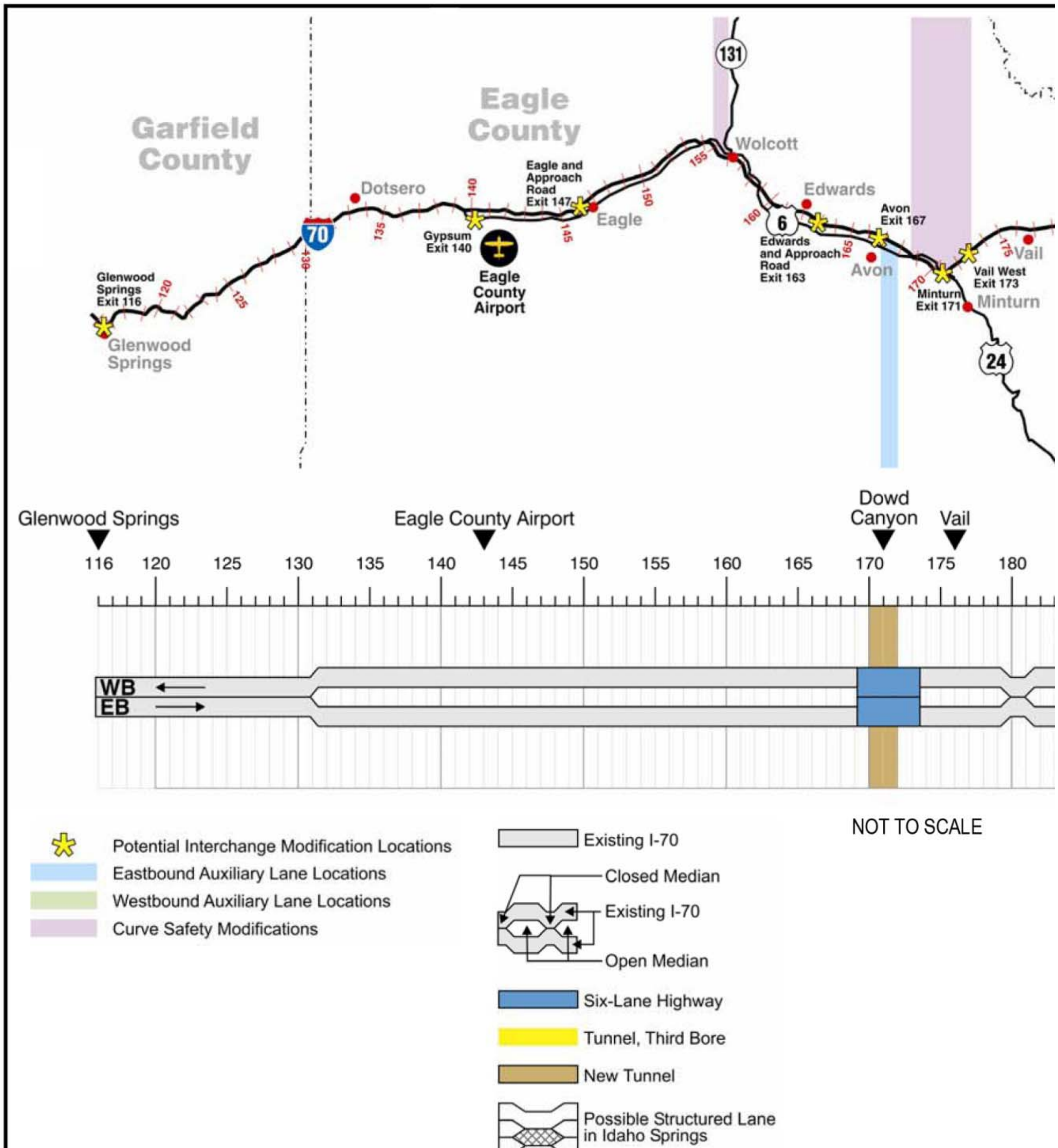
Note: All illustrations view from west to east.

5.3.2 Six-Lane Highway 65 mph Alternative

The Six-Lane Highway 65 mph Alternative would be similar to the Six-Lane Highway 55 mph Alternative (see **Figure 25**). Both alternatives would require new tunnel bores at the Eisenhower-Johnson Memorial Tunnels and Twin Tunnels and snow storage ditches as described and illustrated in the Six-Lane Highway 55 mph Alternative section above. To maintain a 65 mph design speed through Dowd Canyon and Clear Creek Canyon, three new tunnel locations would be required. The specific details of the new tunnels are shown in **Figure 26.**

As illustrated in **Figure 27**, the new Dowd Canyon Tunnel would consist of two new three-lane tunnels, one to accommodate westbound traffic, the other for eastbound traffic. These tunnels are anticipated to be approximately 7,200 feet long. The Hidden Valley Tunnel would consist of one new three-lane tunnel. This would be for westbound traffic only. This tunnel would be approximately 1,400 feet long. Eastbound would roughly follow the existing alignment but would require curve safety modifications in select location to maintain the 65 mph design speed. Also shown in **Figure 27** is the new Floyd Hill tunnel. The new tunnel in this location would consist of one new three-lane tunnel that would accommodate eastbound traffic only. This tunnel is anticipated to be approximately 5,500 feet long.

Figure 25. Six-Lane Highway 65 mph Alternative Overview



Notes:

1) Placement of colored bars indicates whether that portion of the altnernative would be on the north or south side or in the median of existing I-70.
2) Selected localized safety and capacity improvement components of Minimal Action are assumed to be included in each of the action alternatives (interchange modifications, auxilliary lanes, curve safety modifications)

Figure 25. Six-Lane Highway 65 mph Alternative Overview (Continued)

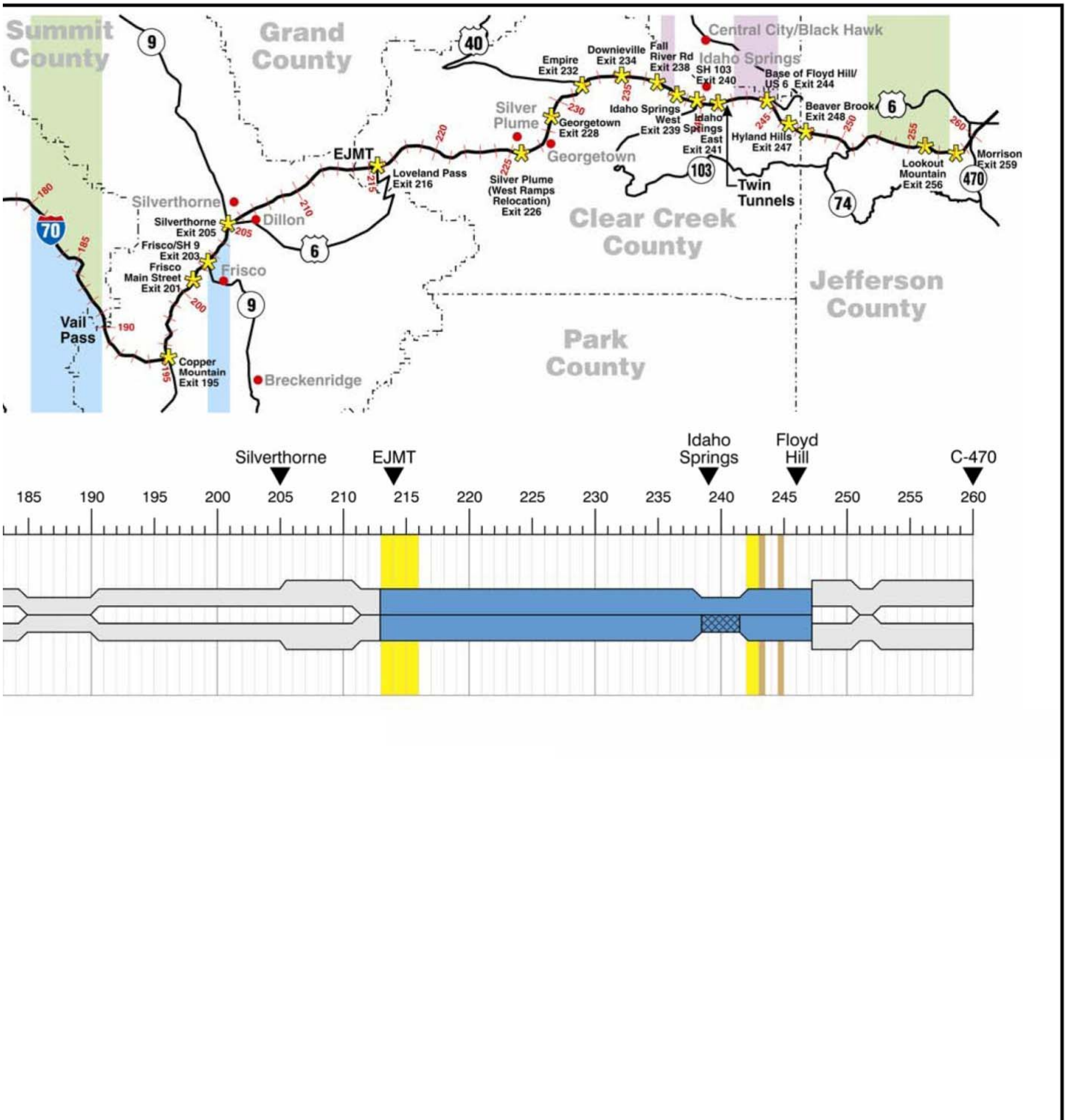
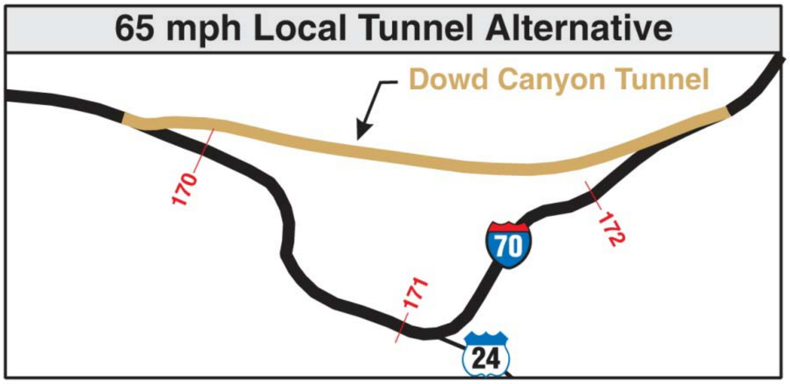
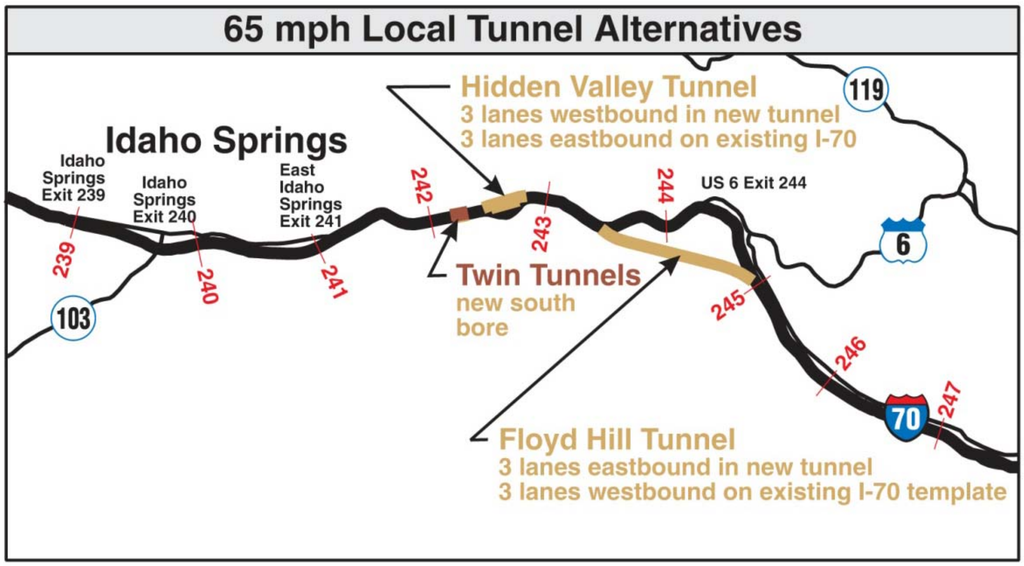


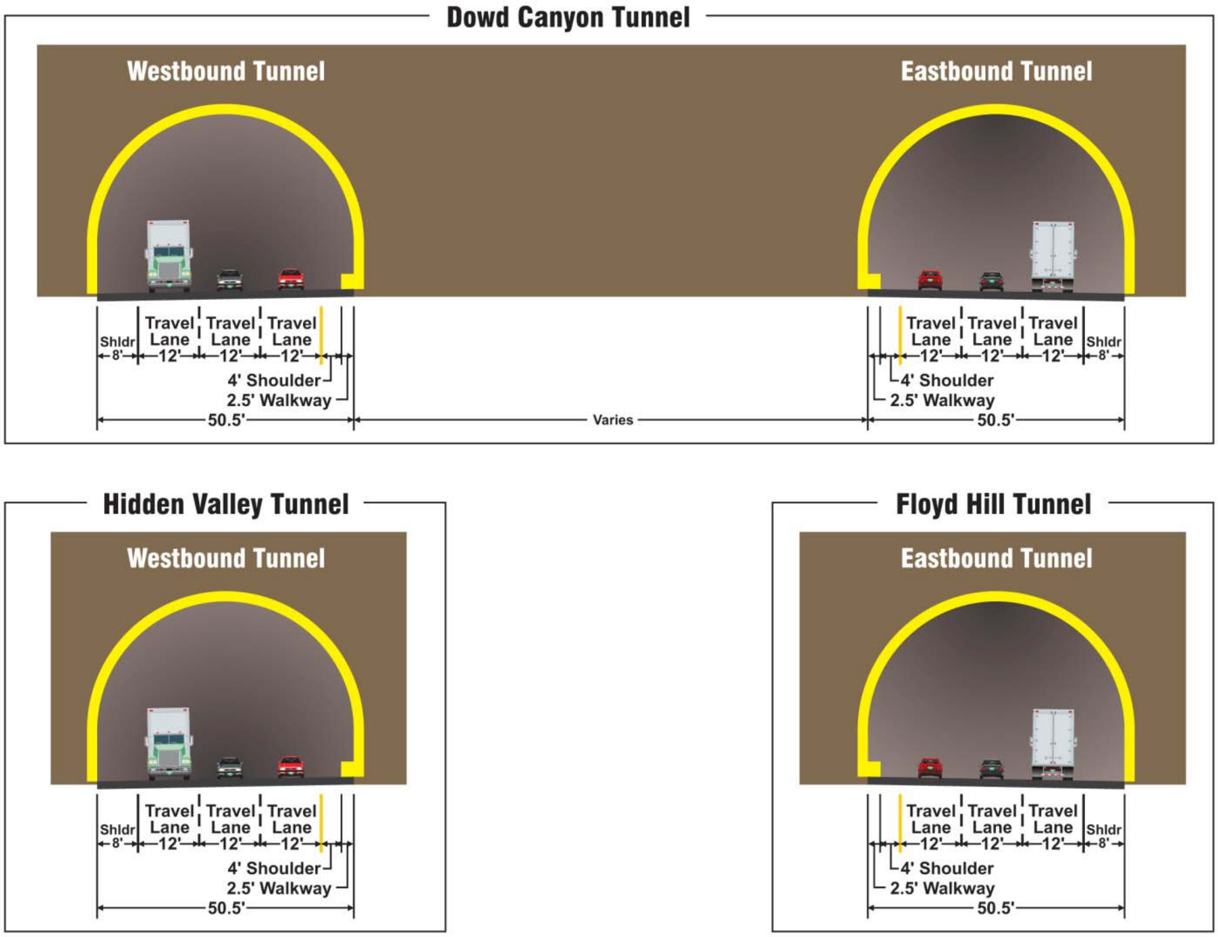
Figure 26. Six-Lane Highway 65 mph Alternative Local Tunnel





Notes: All illustrations view from west to east.

Figure 27. Six-Lane Highway 65 mph Alternative Dowd Canyon Tunnel, Hidden Valley Tunnel, and Floyd Hill Tunnel



Notes: All illustrations view from west to east.

5.3.3 Reversible/High Occupancy Vehicle/High Occupancy Toll Lanes Alternative

The Reversible/High Occupancy Vehicle (HOV)/High Occupancy Toll (HOT) Lanes alternative involves construction of a reversible lane facility that would change traffic flow directions as needed to accommodate peak direction travel demand where lanes have restricted use based on vehicle occupancy. To be able to drive in these lanes, a car must either have three or more passengers in the vehicle (HOV), including the driver, or be willing to pay a toll or fee if there are less than 3 passengers (HOT). Toll collection may use automatic vehicle identification tags, such as the Express Toll transponders currently in use on the E-470 and Northwest Parkway toll roads in the Denver metropolitan area. These types of lanes encourage carpooling and the reversible nature of the lane helps increase road capacity in the direction of heavy travel based on peak travel times.

As shown in **Figure 28**, reversible lanes would be built between the west side of the Eisenhower-Johnson Memorial Tunnels to just east of Hyland Hills. From the Eisenhower-Johnson Memorial Tunnels to just east of the US 6/Clear Creek Canyon at the base of the Floyd Hill interchange, two additional lanes would be provided in the center between the two eastbound and two westbound lanes, separated by a 2 foot barrier. The only entrance and exit from the reversible lanes would be in four locations – two at the termini, one at US 6, and another at the Empire Junction interchange. **Figure 29** shows the typical configuration of the I-70 highway with the reversible/HOV/HOT lanes. This facility would be mostly on grade except for in Idaho Springs where a structure configuration is being considered to minimize the footprint. The eastbound traffic lanes in Idaho Springs would be stacked above the two reversible lanes. The direction of the center lanes would be controlled through access gates and signing to ensure a safe transition as the directions of the lanes change.

Tunnel requirements would be the same as those for Six-Lane Highway 55 mph Alternative. The proposed third tunnel bores at the Eisenhower-Johnson Memorial Tunnels and Twin Tunnels locations are described in Section 5.3 and are shown in **Figure 30**. For each of the tunnels, the reversible lanes would be located in the middle bore.

This alternative would include two additional general-purpose lanes in Dowd Canyon (mileposts 170 to 173), which would not be barrier separated or reversible. A paved ditch would be provided on each side of the highway for snow storage with widths of 11 feet between Eisenhower-Johnson Memorial Tunnels and Herman Gulch (mileposts 213.5 to 218), 9 feet between Herman Gulch and Silver Plume (mileposts 218 to 226), and 2 feet for all other areas of widening. The primary difference in the roadway platform between the Six-Lane Highway 55 mph and the Six-Lane Highway 65 mph alternatives and this alternative would be the presence of an additional set of barriers for the reversible lanes and an extra set of 4-foot and 8-foot shoulders for these lanes. Roadside ditches would be designed to collect snowmelt and control runoff into sediment basins.

The total transportation corridor width would range from 82 to 125 feet.

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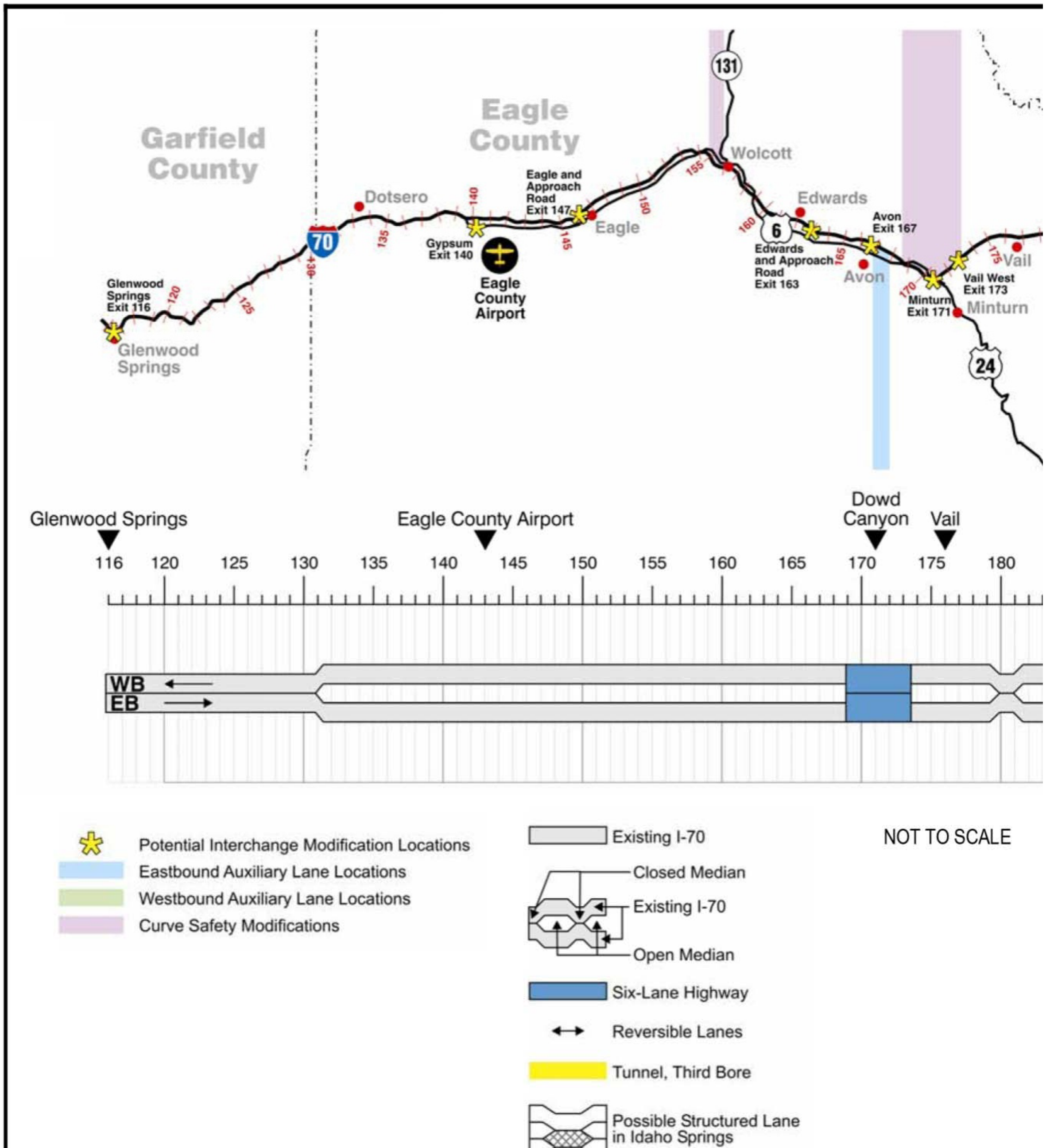
Figure 28. Reversible/High Occupancy Vehicle/High Occupancy Toll Lanes Alternative Overview



Notes:
1) Placement of colored bars indicates whether that portion of the altnernative would be on the north or south side or in the median of existing I-70.
2) Selected localized safety and capacity improvement components of Minimal Action are assumed to be included in each of the action alternatives (interchange modifications, auxilliary lanes, curve safety modifications)

Figure 28. Reversible/High Occupancy Vehicle/High Occupancy Toll Lanes Alternative Overview (Continued)

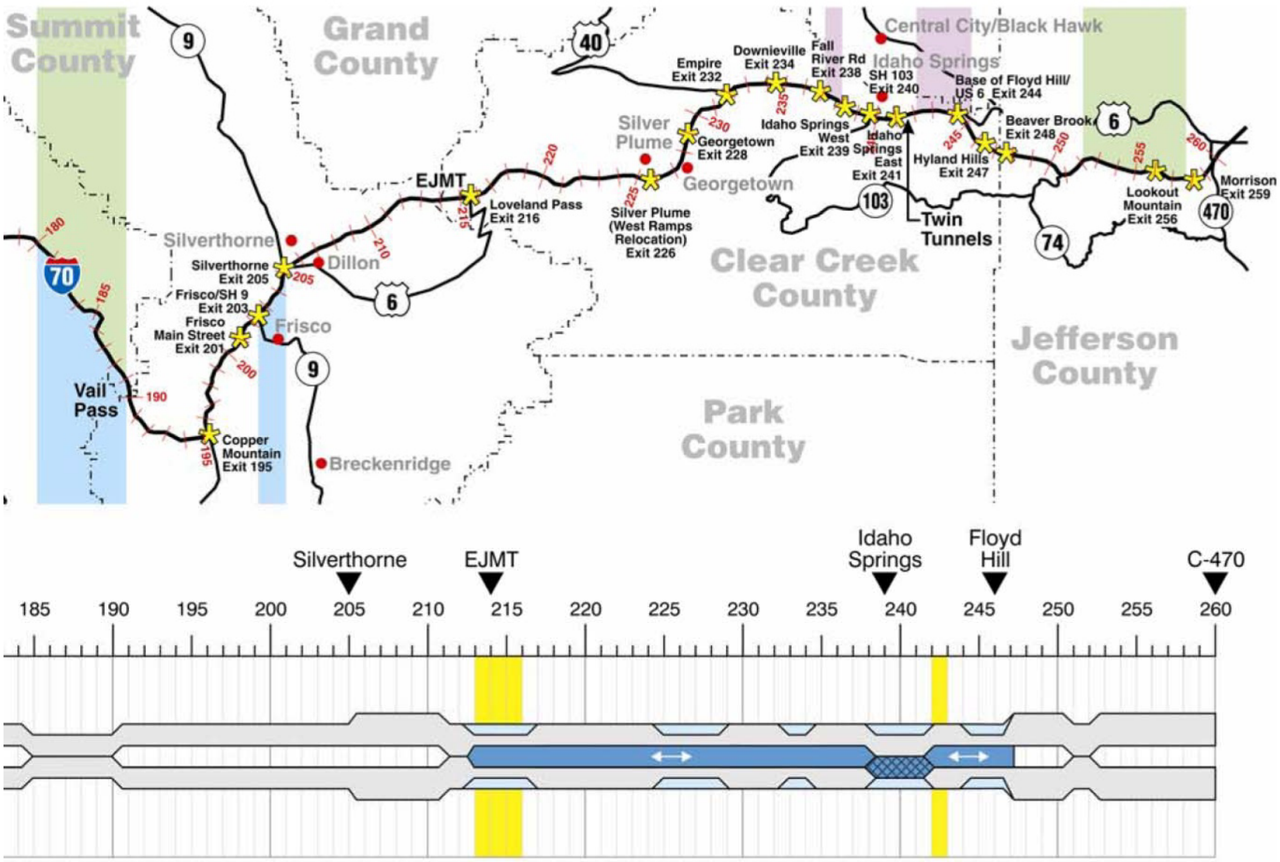
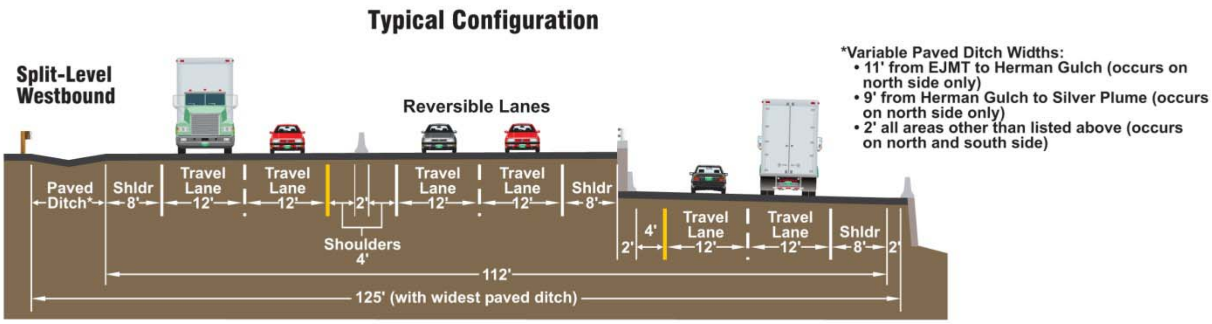
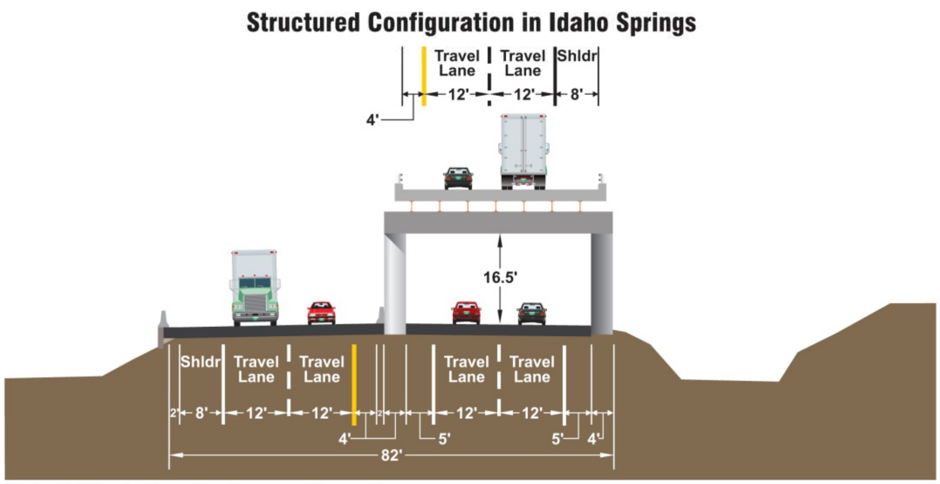


Figure 29. Reversible/High Occupancy Vehicle/High Occupancy Toll Lanes Alternative Typical Configuration and Structured Configuration in Idaho Springs





Note: All illustrations view from west to east.

Figure 30. Reversible/High Occupancy Vehicle/High Occupancy Toll Lanes Alternative Urban Example

Urban example: Reversible Lanes on I-25 in Denver with gates to prevent entry during reverse direction operation.

5.4 Combination Alternatives

Twelve Combination alternatives, combining Highway and Transit alternatives were advanced for consideration in the PEIS. Four of these alternatives involve the buildout of highway and transit components simultaneously. Eight alternatives include preservation options, the intent of which is to include or not preclude space for future modes in the I-70 Mountain Corridor.

Four Combination alternatives with buildout of highway and transit elements simultaneously are:

- Combination Six-Lane Highway with Rail and Intermodal Mountain Connection Alternative
- Combination Six-Lane Highway with Advanced Guideway System Alternative
- Combination Six-Lane Highway with Dual-Mode Bus in Guideway Alternative
- Combination Six-Lane Highway with Diesel Bus in Guideway Alternative

Eight Combination alternatives with preservation of either highway or transit elements are:

- Combination Six-Lane Highway with Rail and Intermountain Connection, Preserve for Transit Alternative
- Combination Six-Lane Highway with Rail and Intermountain Connection Alternative, Preserve for Highway Alternative
- Combination Six-Lane Highway with Advanced Guideway System, Preserve for Transit Alternative
- Combination Six-Lane Highway with Advanced Guideway System, Preserve for Highway Alternative
- Combination Six-Lane Highway with Dual-Mode Bus in Guideway, Preserve for Transit Alternative
- Combination Six-Lane Highway with Dual-Mode Bus in Guideway, Preserve for Highway Alternative
- Combination Six-Lane Highway with Diesel Bus in Guideway, Preserve for Transit Alternative
- Combination Six-Lane Highway with Bus in Diesel Bus in Guideway, Preserve for Highway Alternative

All Transit alternative components are combined with the 55 mph six-lane highway widening to create Combination alternatives. Each Combination Alternative includes variations that construct the transit and preserve the six-lane highway footprint or construct the six-lane highway and preserve the transit footprint. More specifically, preservation options include space for additional modes in the Corridor and do not preclude the ability to construct additional modes in the future.

5.4.1 Combination Six-Lane Highway with Rail and Intermountain Connection Alternative

The Combination Six-Lane Highway with Rail and Intermountain Connection Alternative would provide approximately 35 miles of additional highway capacity and a Rail system in the I-70 Mountain Corridor between the Eagle County Airport (milepost 142) and C-470 (milepost 260). **Figure 31** illustrates the proposed improvements for this alternative. This would include two additional general-purpose highway lanes with a speed of 55 mph and bidirectional rail. Where highway widening would occur (throughout Clear Creek County) rail would be located primarily within the median. This alternative is primarily on grade as shown in the typical configuration in **Figure 32**; however, in Idaho Springs a structured configuration is being considered to minimize impacts to the community. Through Idaho Springs eastbound traffic lanes would be elevated over bidirectional rail.

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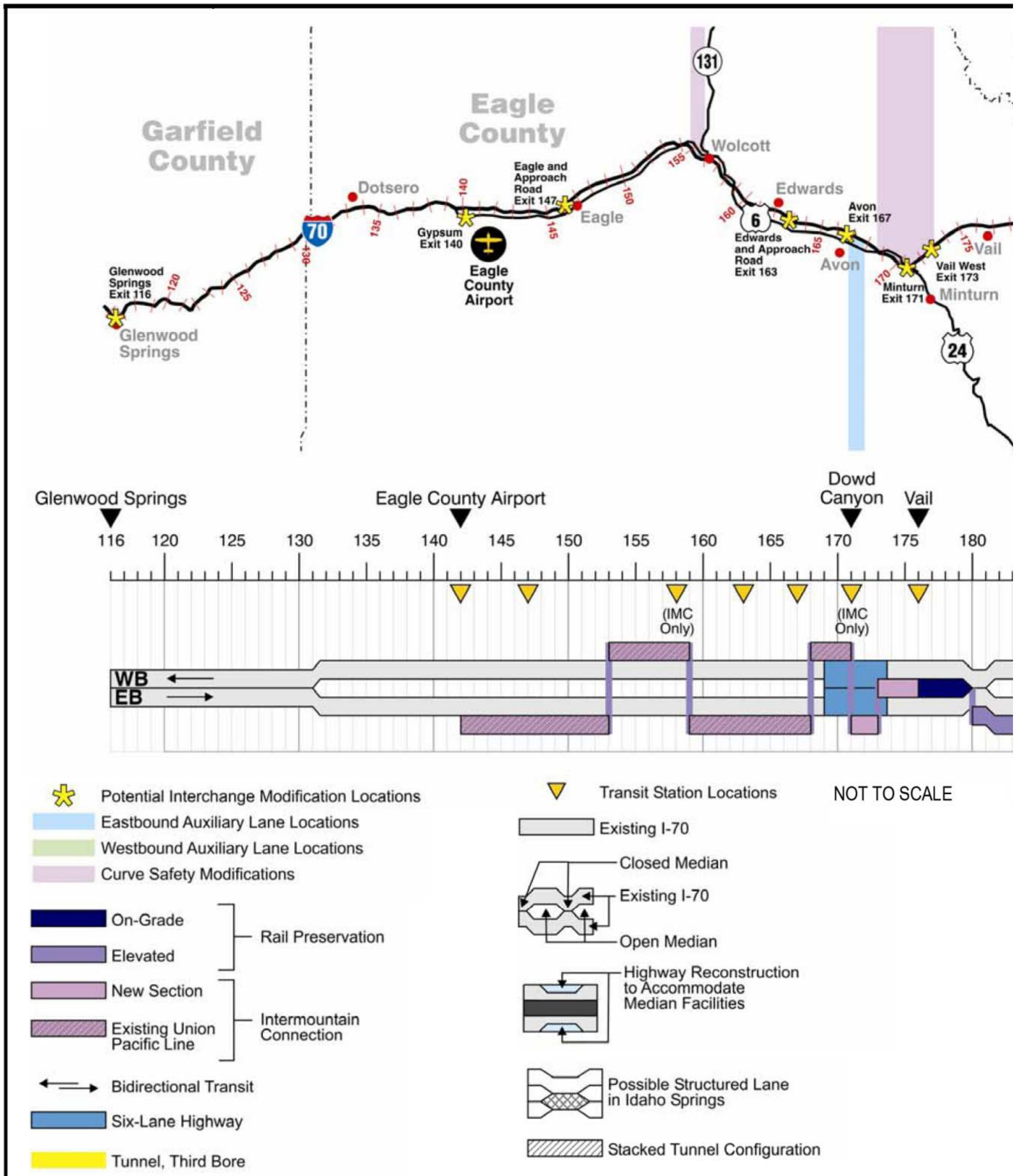
Figure 31. Combination Six-Lane Highway with Rail and Intermountain Connection Alternative Overview



Notes:

1) Placement of colored bars indicates whether that portion of the altnernative would be on the north or south side or in the median of existing I-70.
2) Selected localized safety and capacity improvement components of Minimal Action are assumed to be included in each of the action alternatives (interchange modifications, auxilliary lanes, curve safety modifications)

Figure 31. Combination Six-Lane Highway with Rail and Intermountain Connection Alternative Overview (Continued)

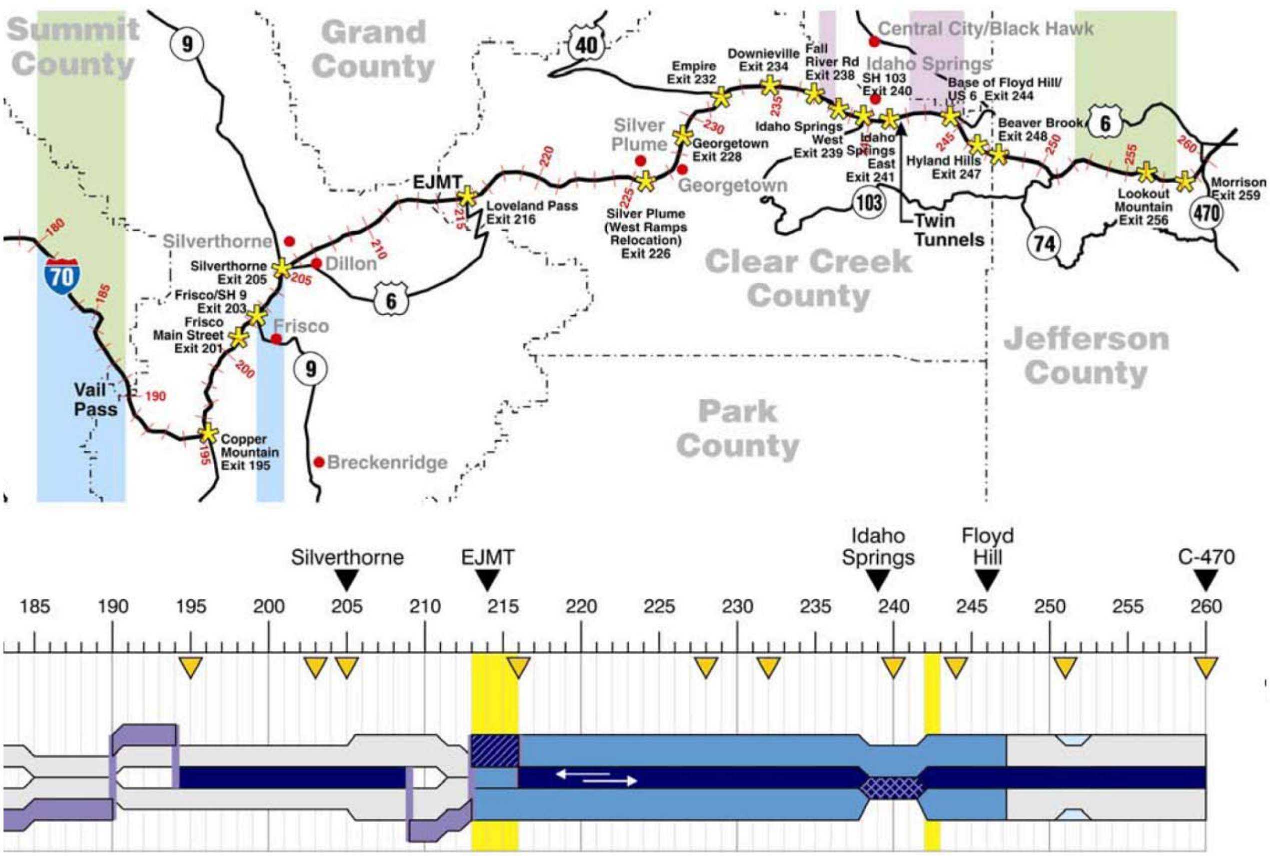
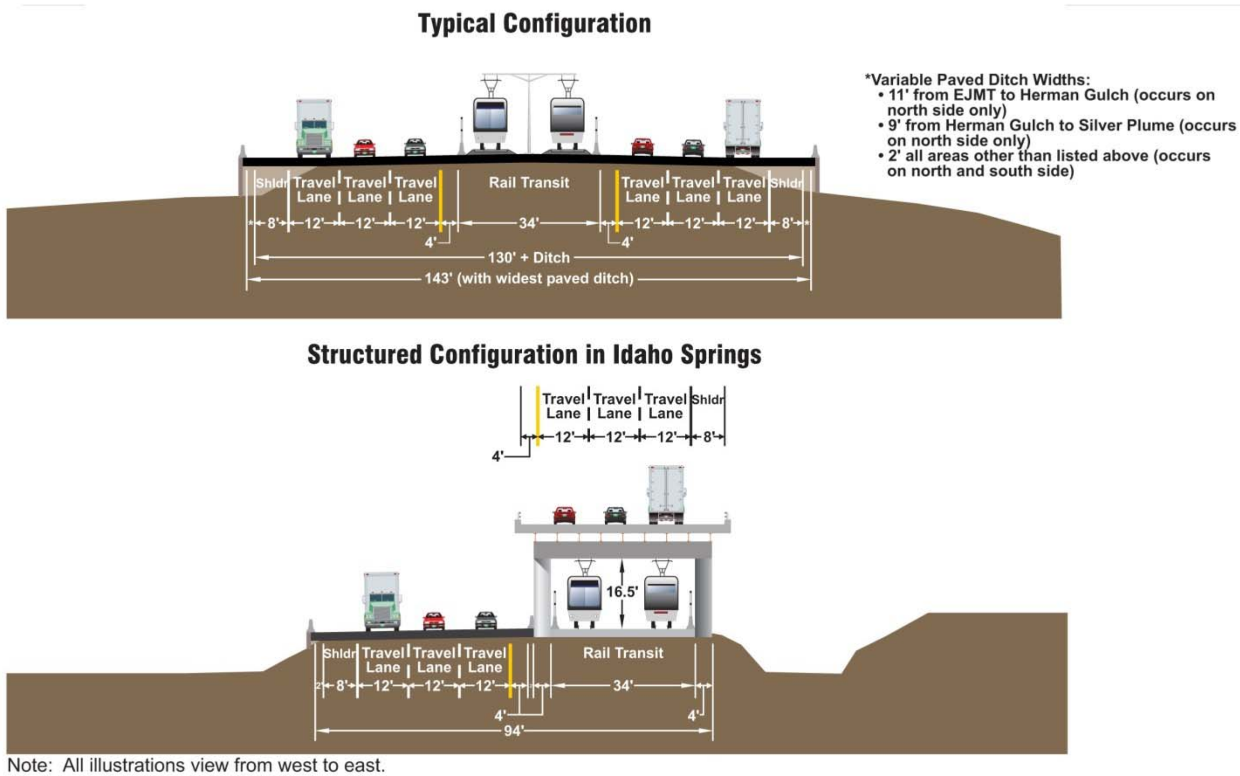


Figure 32. Combination Six-Lane Highway with Rail and Intermountain Connection Alternative Typical Configuration and Structured Configuration in Idaho Springs

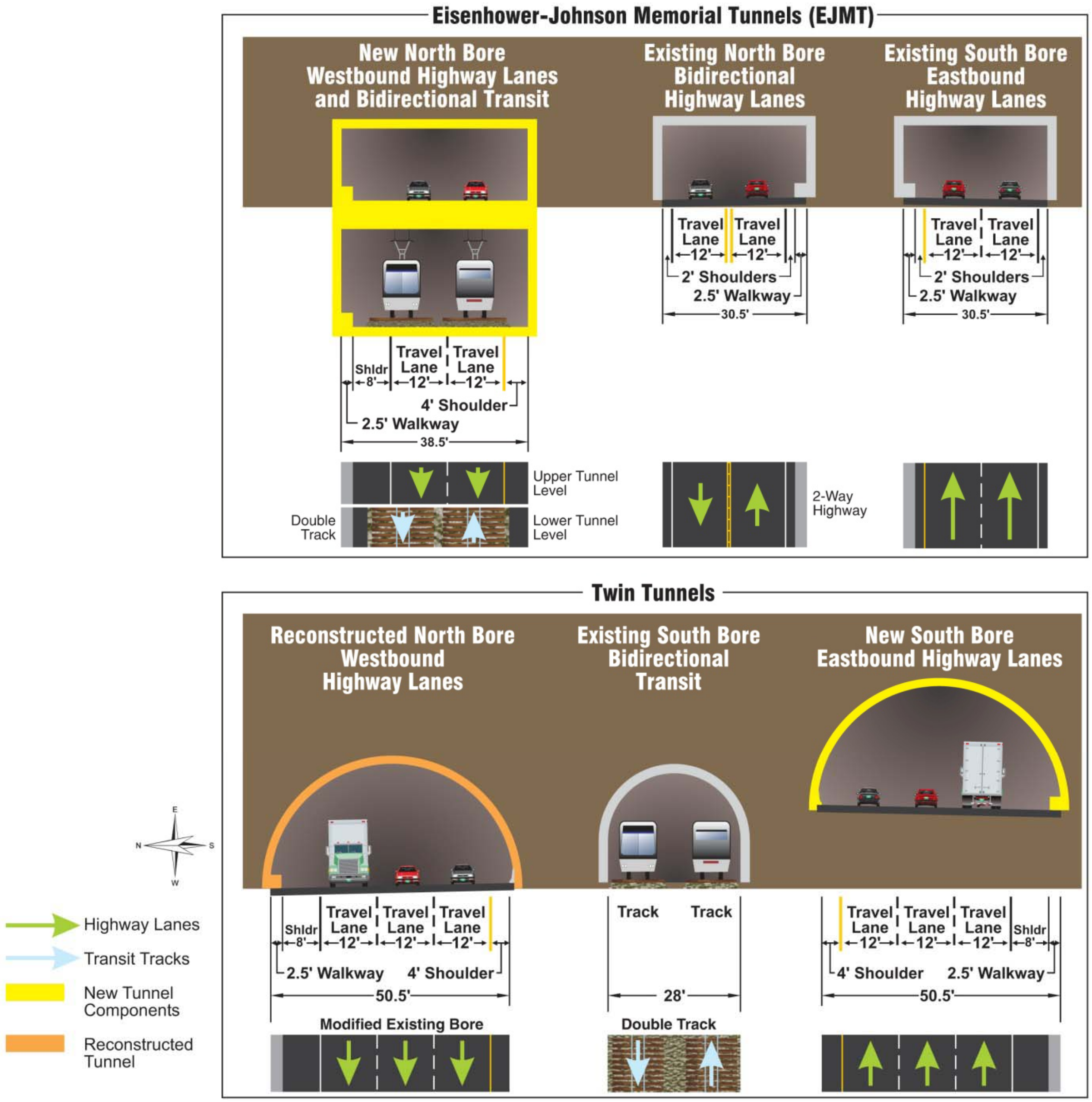


Two general purpose lanes would be added at Dowd Canyon to make it a 6 lane facility between mile posts 170 and 173. Two lanes would also be added between the Eisenhower-Johnson Memorial Tunnels at milepost 215.3 and Floyd Hill at milepost 247. Structured eastbound lanes may be required in the Idaho Springs area (mileposts 238.9 to 241.4.). A paved ditch would be provided on the north side of the highway for snow storage with widths as follows: 11 feet from Eisenhower-Johnson Memorial Tunnels to Herman Gulch (mileposts 215.3 to 218), 9 feet from Herman Gulch to Silver Plume (mileposts 218 to 226), and 2 feet for all other areas of widening. Snow storage is proposed to be provided on only one side of the highway rather than on both sides.

This alternative would require third tunnel bores at the existing Eisenhower-Johnson Memorial Tunnels and Twin Tunnels locations. As shown in **Figure 33**, The proposed third tunnel bore in the Eisenhower-Johnson Memorial Tunnels would be located north of the existing tunnel bores and would accommodate westbound highway traffic and bidirectional rail with the highway lanes above the rail. The exiting north bore would accommodate two lanes of bidirectional highway traffic and the exiting south bore would allow for two lanes of eastbound traffic. The proposed length of the tunnel would be 14,500 feet. For the Twin Tunnels, the existing north bore would be reconstructed from its current width of 28 feet to accommodate three lanes of westbound highway traffic. The tunnel is anticipated to be approximately 740 feet long. The existing south bore would accommodate bidirectional rail and the proposed third tunnel bore would be located south of the rail tunnel and would accommodate three lanes of eastbound traffic.

The Scott Lancaster Memorial Bike Path bridge over Clear Creek would be impacted if the tunnel bore were not elevated. In the Tier 2 process, options for this tunnel approach could consider relocating the trail and keeping the eastbound tunnel approach on grade, which would reduce tunnel costs.

Figure 33. Combination Six-Lane Highway with Rail and Intermountain Connection Alternative Eisenhower-Johnson Memorial Tunnels and Twin Tunnels



Note: All illustrations view from west to east.

5.4.2 Combination Six-Lane Highway Alternative with Advanced Guideway System Alternative

The Combination Six-Lane Highway with Advanced Guideway System alternative would provide approximately 35 miles of additional highway capacity and a future Advanced Guideway System in the Corridor from Eagle County Airport (milepost 142) to C-470 (milepost 260). The description of this alternative is similar to the description of the Combination Six-Lane Highway with Rail and Intermountain Connection Alternative and all of the improvements to the roads and tunnels would be the same. The only difference is that this alternative rail technology is an Advanced Guideway System instead of the rail and Intermountain Connection. For a description of the Advanced Guideway System, see the description of the Advanced Guideway System Alternative in **Section 5.2** of this report.

5.4.3 Combination Six-Lane Highway with Dual-Mode Bus in Guideway Alternative

The Combination Six-Lane Highway with Dual-Mode or Diesel Bus in Guideway alternatives would provide approximately 35 miles of additional highway capacity and a guideway bus system in the I-70 Mountain Corridor between Eagle County Airport (milepost 142) and C-470 (milepost 260). **Figure 22** illustrates the proposed improvements for this alternative. Two additional general-purpose highway lanes with speeds of 55 mph would be added at Dowd Canyon and between the Eisenhower-Johnson Memorial Tunnels and Floyd Hill. A description of the proposed highway improvements with illustrations is located in **Section 5.3** under the Six-Lane Highway 55 mph Alternative.

A guideway would be constructed in the I-70 highway median for the operation of dual-mode buses (electric and diesel powered buses). A description of the guideway and details on the operation of the bus service for this alternative can be found in the Dual-Mode Bus in Guideway Alternative in **Section 5.3** of this report.

5.4.4 Combination Six-Lane Highway with Diesel Bus in Guideway Alternative

The Combination Six-Lane Highway with Diesel-Mode in Guideway alternative would provide approximately 35 miles of additional highway capacity and a guideway bus system in the I-70 Mountain Corridor between Eagle County Airport (milepost 142) and C-470 (milepost 260). **Figure 22** illustrates the proposed improvements for this alternative. Two additional general-purpose highway lanes with speeds of 55 mph would be added at Dowd Canyon and between the Eisenhower-Johnson Memorial Tunnels and Floyd Hill. A description of the proposed highway improvements with illustrations is located in **Section 5.3** under the Six-Lane Highway 55 mph Alternative.

A guideway would be constructed in the I-70 highway median for the operation of diesel powered buses. A description of the guideway and details on the operation of the bus service for this alternative can be found in the Diesel Bus in Guideway Alternative in **Section 5.3** of this report.

5.4.5 Preservation Alternatives

Eight Preservation Combination alternatives are being considered in the PEIS. These alternatives have been developed to assess future multimodal transportation systems for the I-70 Mountain Corridor. Unlike the “build” Combination alternatives described above that combine Six-Lane Highway with Transit (Rail, Advanced Guideway System, or Bus in Guideway systems), the intent of the Preservation Combination alternatives is to include or not preclude space for future modes in the Corridor.

At the Tier 1 level of the National Environmental Policy Act (NEPA) process, the Colorado Department of Transportation is assuming the following concepts for accommodating or not precluding future transit in the I-70 Mountain Corridor PEIS.

Preservation-Inclusion Option

- The Inclusion Option would involve planning and designing the initial transportation mode, while “preserving” the three-dimensional space for the future mode.
- The “space” for the future transportation mode would be developed at the time that the selected alternative would be implemented. This could require acquiring right-of-way, making interchange

modifications, or installing walls that would be sized and located to be compatible with the ultimate multimodal transportation template.

- Most environmental effects would be based on the total footprint of the combined alternative although there are exceptions, which are noted below.
- The "need" (mobility) analyses would account for only the build portion.
- Cost estimates would be modified to reflect only the build portion and the cost to preserve the three-dimensional space for the future action.
- Intergovernmental transportation coordination strategies would be key components to the development of a future multimodal Corridor.

Preservation-Nonpreclusion Option

- The Nonpreclusion Option for the preservation of transit would be to plan and design the initial transportation mode in such a manner as to "not preclude" a future mode.
- With this approach, a six-lane highway would be developed as a part of the 20-year plan, in a manner that would not involve interchange modifications or developing the space for a future transit system as with the Inclusion Option.
- To place a future transit into the median of a six-lane highway under the Nonpreclusion Option, the highway would have to be rebuilt by widening to the outside for the highway lanes to make space for the transit system in the median.
- Interchange modifications, walls, and other earthwork would be done at the time when the future transit mode would be implemented.
- This approach would minimize the investment in the future mode until such time when it would be implemented.
- Coordinated transportation strategies with appropriate jurisdictions and land management agencies would be required.

Approaches for integrating future transit in theI-70 Mountain Corridor could be reviewed in the Tier 2 process. Decisions could be made at that time as to Inclusion versus Nonpreclusion options. Refinements could modify the Tier 1 template if financially or environmentally beneficial, if not to the detriment of the preservation commitment. Any purchase of right-of-way for preservation would be further evaluated during Tier 2 analysis.

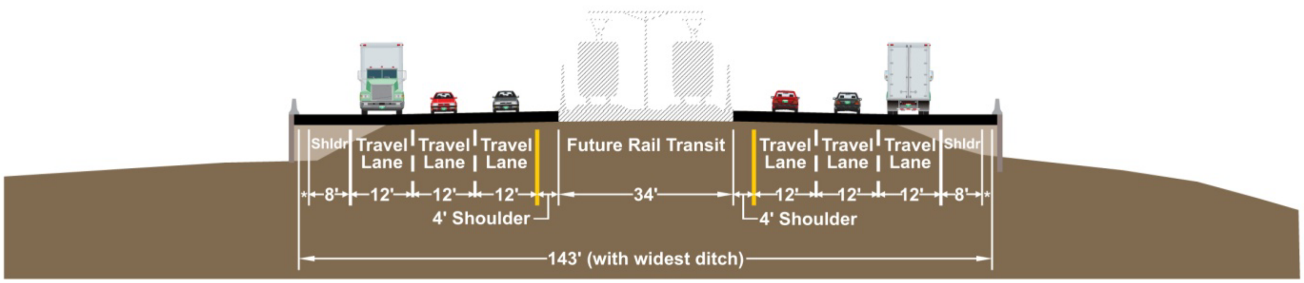
The preservation footprint would be highly variable depending on construction phasing and approach. For example, some infrastructure components, such as retaining walls or the bus guideway, may be built to their final configuration. Other components, such a highway lanes, may be converted to another mode later. See the descriptions of the Combination alternatives below for the maximum or ultimate footprint of the Transit alternatives with Highway Preservation. Similarly, see the Highway alternatives for the maximum footprint of the Highway with Transit Preservation alternatives. The preservation footprints assumed for analysis would depend on the resource being analyzed. For some resources, the total of the Combination alternative would be analyzed. For other resources, delaying full construction would delay the impact on the resources and the benefit from transportation expansion.

The following are alternatives evaluated for preserving or not precluding a future mode in the Corridor.

5.4.6 Combination Six-Lane Highway with Rail and Intermountain Connection, Preserve for Transit Alternative

The Combination Six-Lane Highway with Rail and Intermountain Connection, Preserve for Transit Alternative would provide approximately 35 miles of additional highway capacity and preserve space for a Rail system in the I-70 Mountain Corridor between the Eagle County Airport (milepost 142) and C-470 (milepost 260). A typical cross-section is shown in **Figure 34.** The rail graphic has screened out the rail transit feature to illustrate where the rail transit would be placed in the future. Details of the Combination Six-Lane Highway with Rail and Intermountain Connection Alternative are in **Section 5.4.1** of this report.

Figure 34. Highway with Rail Preservation



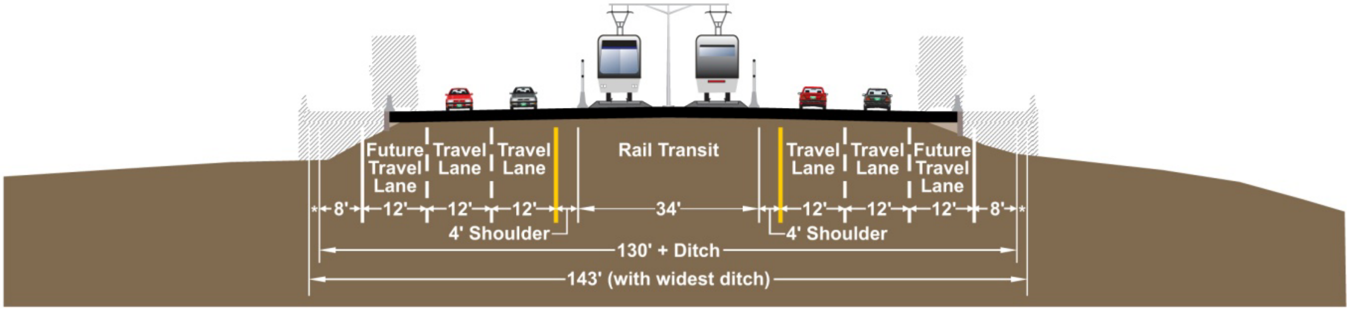
*Variable Paved Ditch Widths:
- 11' from EJMT to Herman Gulch (occurs on north side only)
- 9' from Herman Gulch to Silver Plume (occurs on north side only)
- 2' all areas other than listed above (occurs on north and south side)

Note: All illustrations view from west to east.

5.4.7 Combination Six-Lane Highway with Rail and Intermountain Connection, Preserve for Highway Alternative

The Combination Six-Lane Highway with Rail and Intermountain Connection, Preserve for Highway Alternative would preserve space for approximately 35 miles of additional highway capacity and provide a Rail system in the I-70 Mountain Corridor between the Eagle County Airport (milepost 142) and C-470 (milepost 260). A typical cross-section is shown in **Figure 35.** Note how the outside lanes are screened back to indicate that these lanes would be added in the future sometime after the rail improvements are made. Details of the Combination Six-Lane Highway with Rail and Intermountain Connection Alternative are in **Section 5.4.1** of this report.

Figure 35. Rail with Highway Preservation



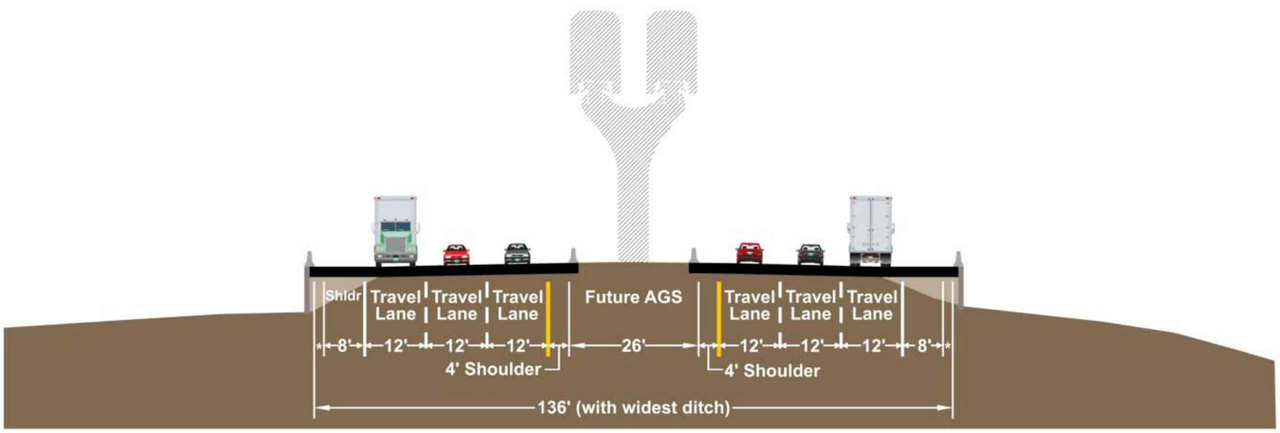
*Variable Paved Ditch Widths:
- 11' from EJMT to Herman Gulch (occurs on north side only)
- 9' from Herman Gulch to Silver Plume (occurs on north side only)
- 2' all areas other than listed above (occurs on north and south side)

Note: All illustrations view from west to east.

5.4.8 Combination Six-Lane Highway with Advanced Guideway System, Preserve for Transit Alternative

The Combination Six-Lane Highway with Advanced Guideway System, Preserve for Transit Alternative would provide approximately 35 miles of additional highway capacity in the I-70 highway and preserve space for a future Advanced Guideway System along the I-70 highway between the Eagle County Airport (milepost 142) and C-470 (milepost 260). A typical cross-section is shown in **Figure 36**. Note that the Advanced Guideway System is screened back to illustrate where the right of way for the train would be preserved to allow for construction of the train at a later date. Details of the Combination Six-Lane Highway with Advanced Guideway System Alternative are in Section 4 of this report.

Figure 36. Highway with Advanced Guideway System Preservation



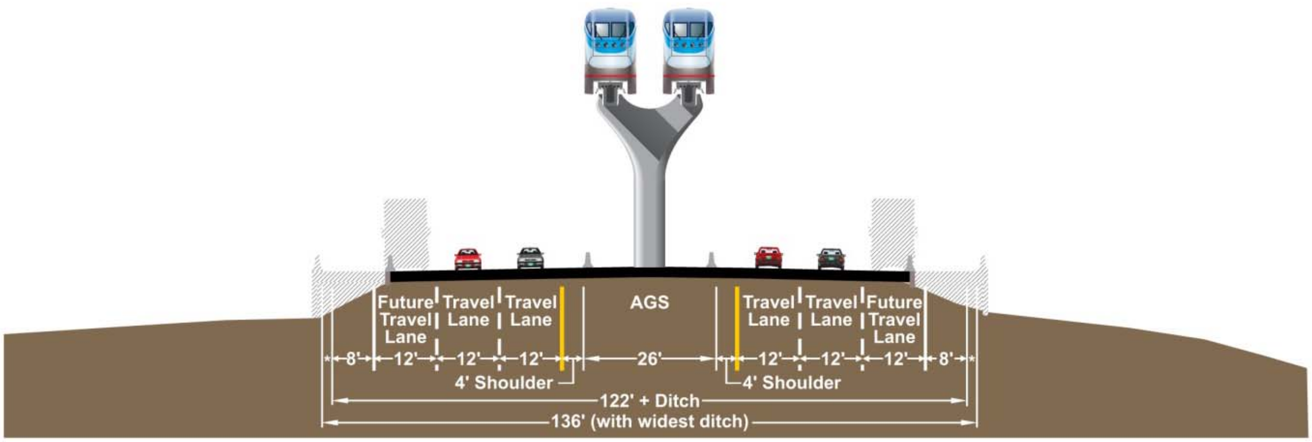
*Variable Paved Ditch Widths:
- 11' from EJMT to Herman Gulch (occurs on north side only)
- 9' from Herman Gulch to Silver Plume (occurs on north side only)
- 2' all areas other than listed above (occurs on north and south side)

Note: All illustrations view from west to east.

5.4.9 Combination Six-Lane Highway with Advanced Guideway System, Preserve for Highway Alternative

The Combination Six-Lane Highway with Advanced Guideway System, Preserve for Highway Alternative would preserve space for approximately 35 miles of additional highway capacity and provide an Advanced Guideway System along the I-70 highway between the Eagle County Airport (milepost 142) and C-470 (milepost 260). A typical cross-section is shown in **Figure 37**. Note that the added highway lanes are screened back to illustrate where the road improvements would be constructed sometime after the Advanced Guideway System. Details of the Combination Six-Lane Highway with Advanced Guideway System Alternative are in Section 4 of this report.

Figure 37. Advanced Guideway System with Highway Preservation



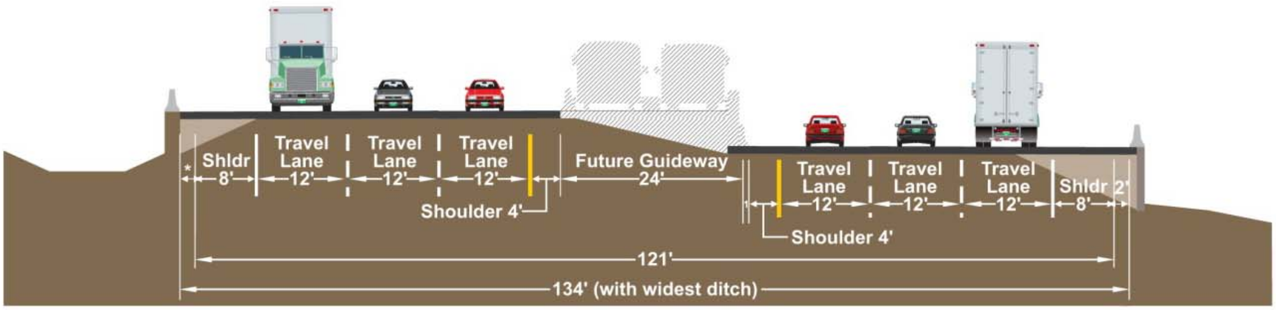
*Variable Paved Ditch Widths:
- 11' from EJMT to Herman Gulch (occurs on north side only)
- 9' from Herman Gulch to Silver Plume (occurs on north side only)
- 2' all areas other than listed above (occurs on north and south side)

Note: All illustrations view from west to east.

5.4.10 Combination Six-Lane Highway with Dual-Mode Bus in Guideway, Preserve for Transit Alternative

The Combination Six-Lane Highway with Dual-Mode in Guideway alternatives would provide approximately 35 miles of additional highway capacity and provide space for a guideway bus system in the I-70 Mountain Corridor between Eagle County Airport (milepost 142) and C-470 (milepost 260). A typical cross-section is shown in **Figure 38**. The screened out buses in the drawing indicate where the future guideway would be constructed sometime after the highway improvements are made. Details of the Combination Six-Lane Highway with Dual-Mode Bus in Guideway Alternative are in Section 4 of this report.

Figure 38. Highway with Bus in Guideway Preservation



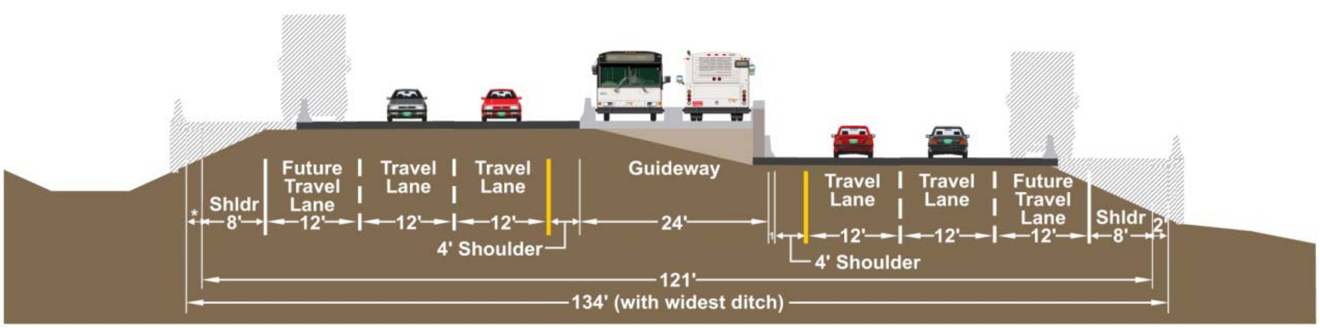
*Variable Paved Ditch Widths:
- 11' from EJMT to Herman Gulch (occurs on north side only)
- 9' from Herman Gulch to Silver Plume (occurs on north side only)
- 2' all areas other than listed above (occurs on north and south side)

Note: All illustrations view from west to east.

5.4.11 Combination Six-Lane Highway with Dual-Mode Bus in Guideway, Preserve for Highway Alternative

The Combination Six-Lane Highway with Dual-Mode in Guideway alternatives would provide space for approximately 35 miles of additional highway capacity and provide a guideway bus system in the I-70 Mountain Corridor between Eagle County Airport (milepost 142) and C-470 (milepost 260). A typical cross-section is shown in **Figure 39**. The screened out lanes in the drawing indicate where the future lanes would be constructed sometime after the bus guideway improvements are made. Details of the Combination Six-Lane Highway with Dual-Mode Bus in Guideway Alternative are in Section 4 of this report.

Figure 39. Bus in Guideway with Highway Preservation



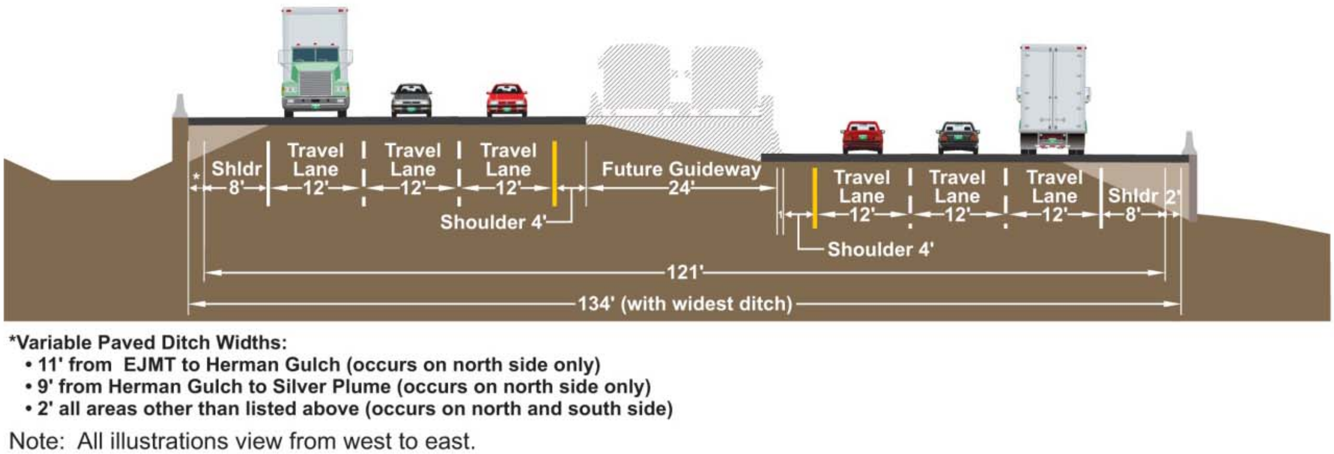
*Variable Paved Ditch Widths:
- 11' from EJMT to Herman Gulch (occurs on north side only)
- 9' from Herman Gulch to Silver Plume (occurs on north side only)
- 2' all areas other than listed above (occurs on north and south side)

Note: All illustrations view from west to east.

5.4.12 Combination Six-Lane Highway with Diesel Bus in Guideway, Preserve for Transit Alternative

This alternative is similar to the Combination Six-Lane Highway with Dual-Mode Bus in Guideway, Preserve for Transit Alternative described above in **Section 5.4**. The difference is that the future buses used in this alternative would be powered by diesel fuel. **Figure 40** shows a cross section of the I-70 highway with the screened out buses showing where space would be preserved for a diesel bus guideway.

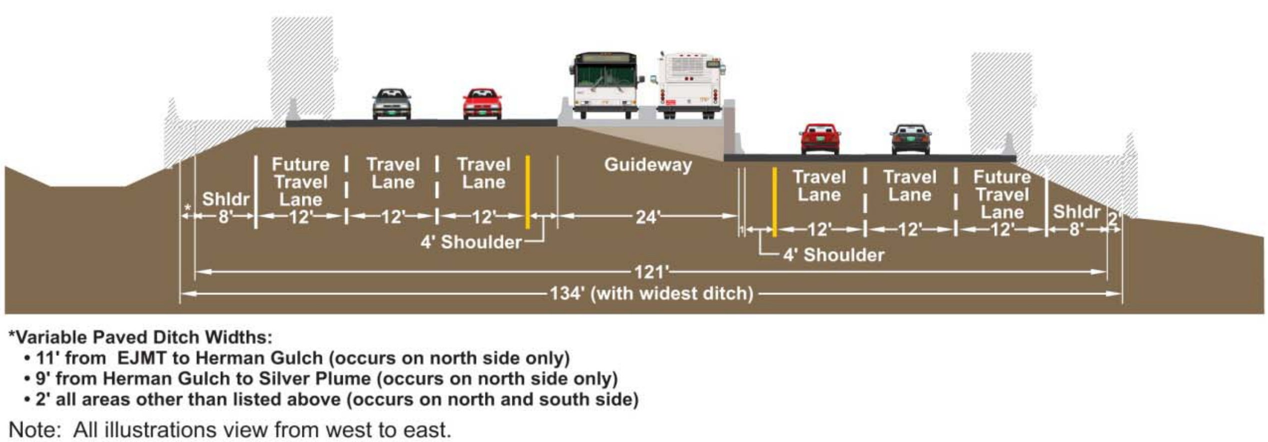
Figure 40. Highway with Bus in Guideway Preservation



5.4.13 Combination Six-Lane Highway with Bus in Diesel Bus in Guideway, Preserve for Highway Alternative

This alternative is similar to the Combination Six-Lane Highway with Diesel Bus in Guideway, Preserve for Transit Alternative described above in **Section 5.4**. The difference is that the buses used in this alternative would be powered by diesel fuel. **Figure 41** shows a cross section of the space preserved for I-70 highway improvements and the guideway improvements.

Figure 41. Bus in Guideway with Highway Preservation



5.5 Preferred Alternative—Minimum and Maximum Program

The Preferred Alternative consists of near-term and general long-term improvements for the Corridor (see **Figure 42 and Figure 43**). These improvements meet the travel demand for 2050 and address the immediate needs in the Corridor. To achieve the long-term demand and address the future uncertainties, trigger points (see **Section 2.7.2** for details) and stakeholder involvement would be used to reassess the Corridor needs to determine the most appropriate transportation improvements to meet the future demands within the Corridor.

The Preferred Alternative is a multimodal solution and includes non-infrastructure related components, Advanced Guideway System, and highway improvements.

Non-infrastructure Related Components

These strategies can begin in advance of major infrastructure improvements to address immediate issues in the Corridor. These strategies and the potential tactics for implementation require actions and leadership by agencies, municipalities, and other stakeholders beyond the lead agencies. The strategies include, but are not limited to:

- Increased enforcement
- Bus, van, or shuttle service in mixed traffic
- Programs for improving truck movements
- Driver education
- Expanded use of existing transportation infrastructure in and adjacent to the Corridor
- Use of technology advancements and improvements to increase mobility without additional infrastructure
- Traveler information and other Intelligent Transportation Systems
- Shift passenger and freight travel demand by time of day and day of week
- Convert day trips to overnight stays
- Promote high occupancy travel and public transportation
- Convert single-occupancy vehicle commuters to high occupancy travel and/or public transportation
- Implement transit promotion and incentives
- Other Travel Demand Management measures to be determined

Figure 42. Preferred Alternative Near Term – Advanced Guideway System with Specific Highway Improvements – 55 and 65 mph Options

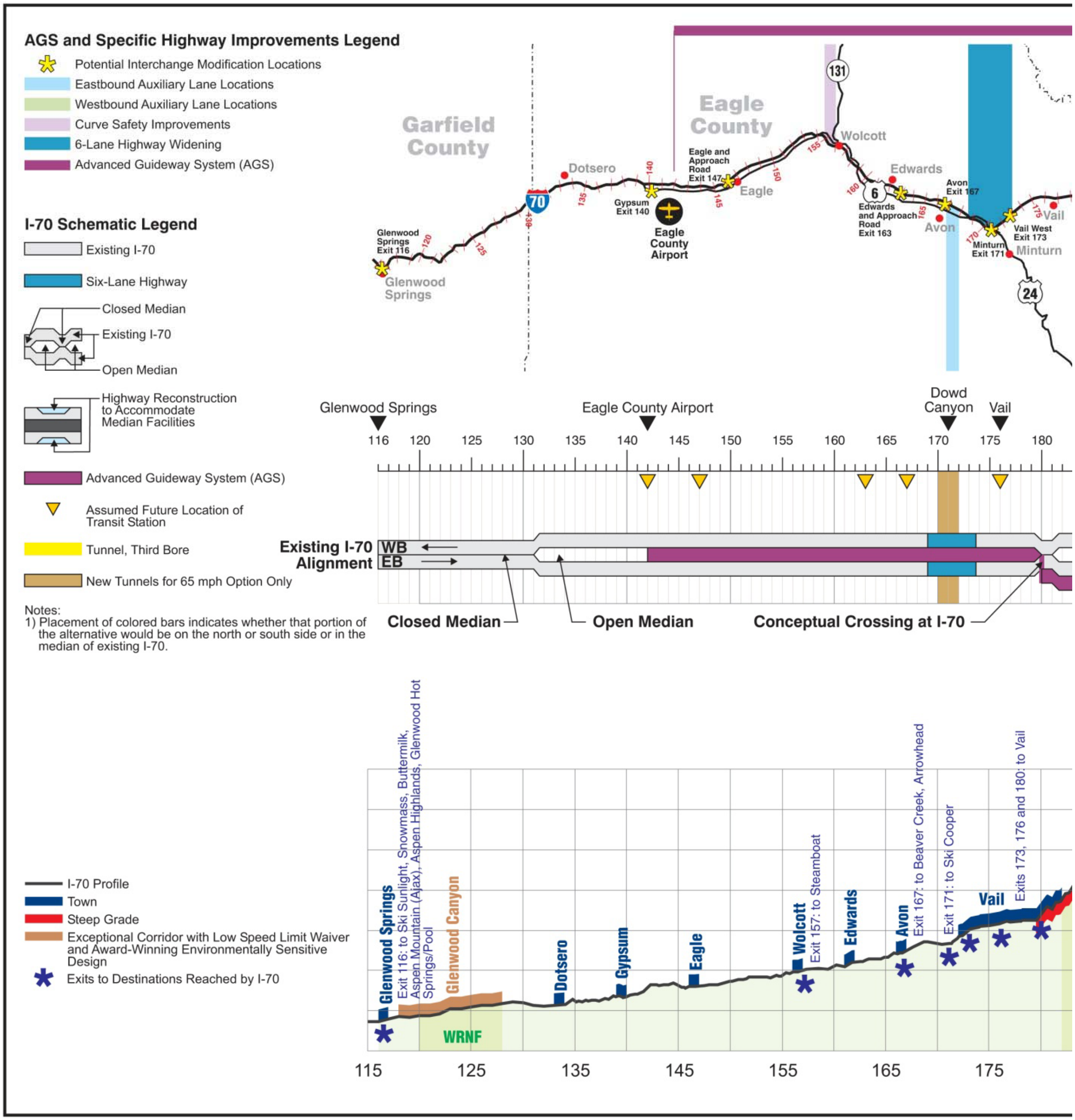


Figure 42. Preferred Alternative Near Term – Advanced Guideway System with Specific Highway Improvements – 55 and 65 mph Options (Continued)

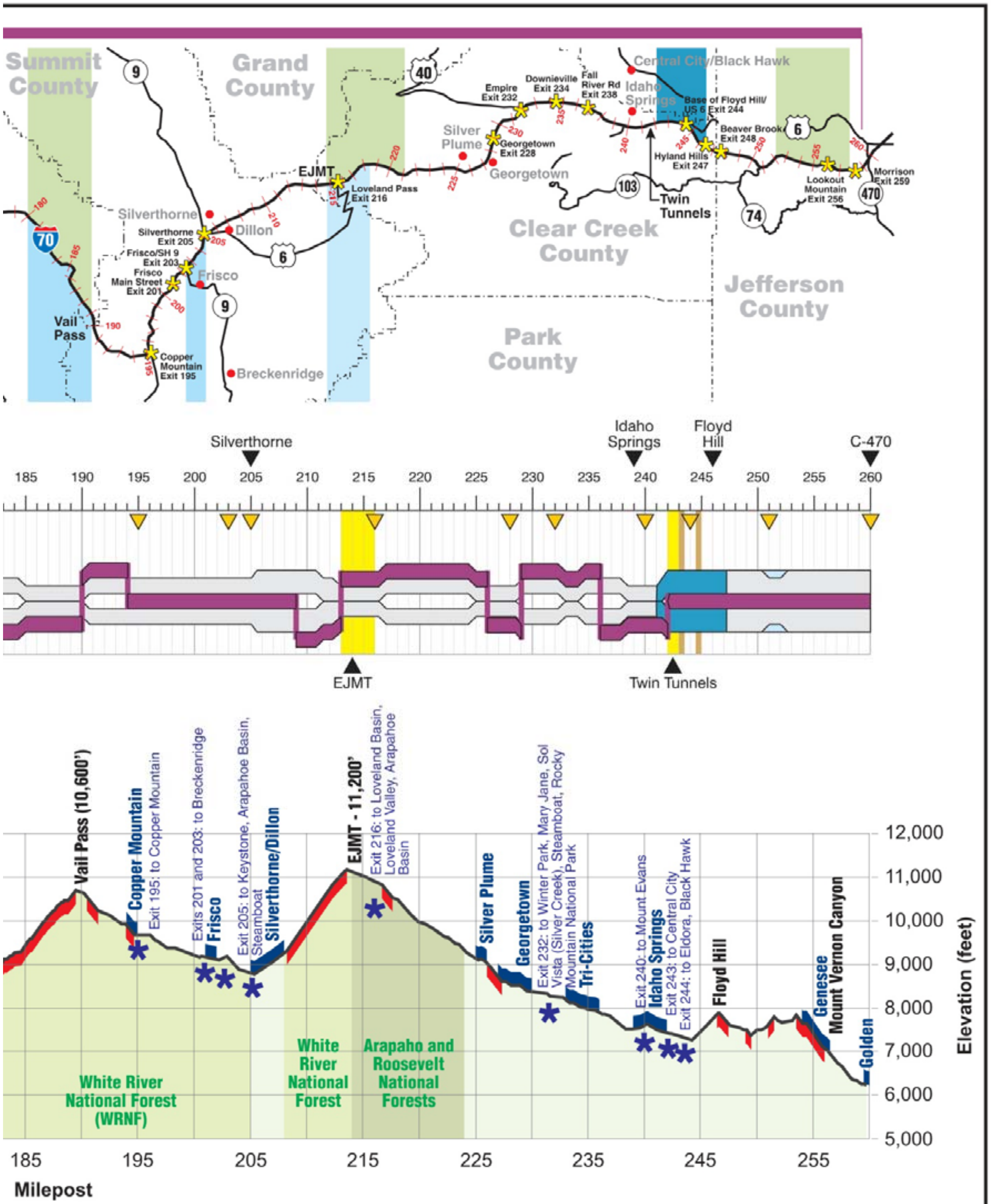


Figure 43. Preferred Alternative – Long Term – Combination 6-Lane Highway with AGS – 55 and 65 mph Options

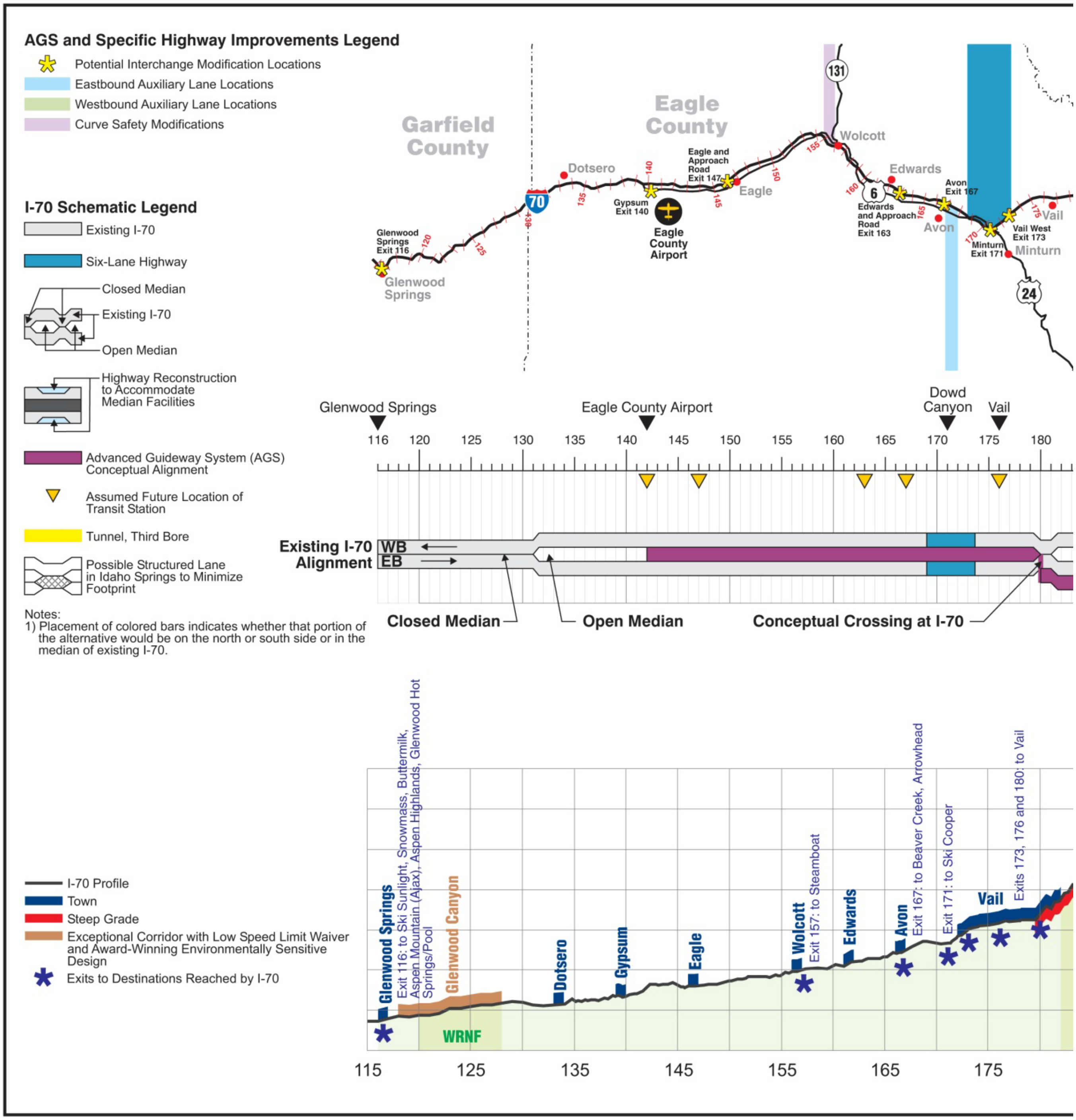
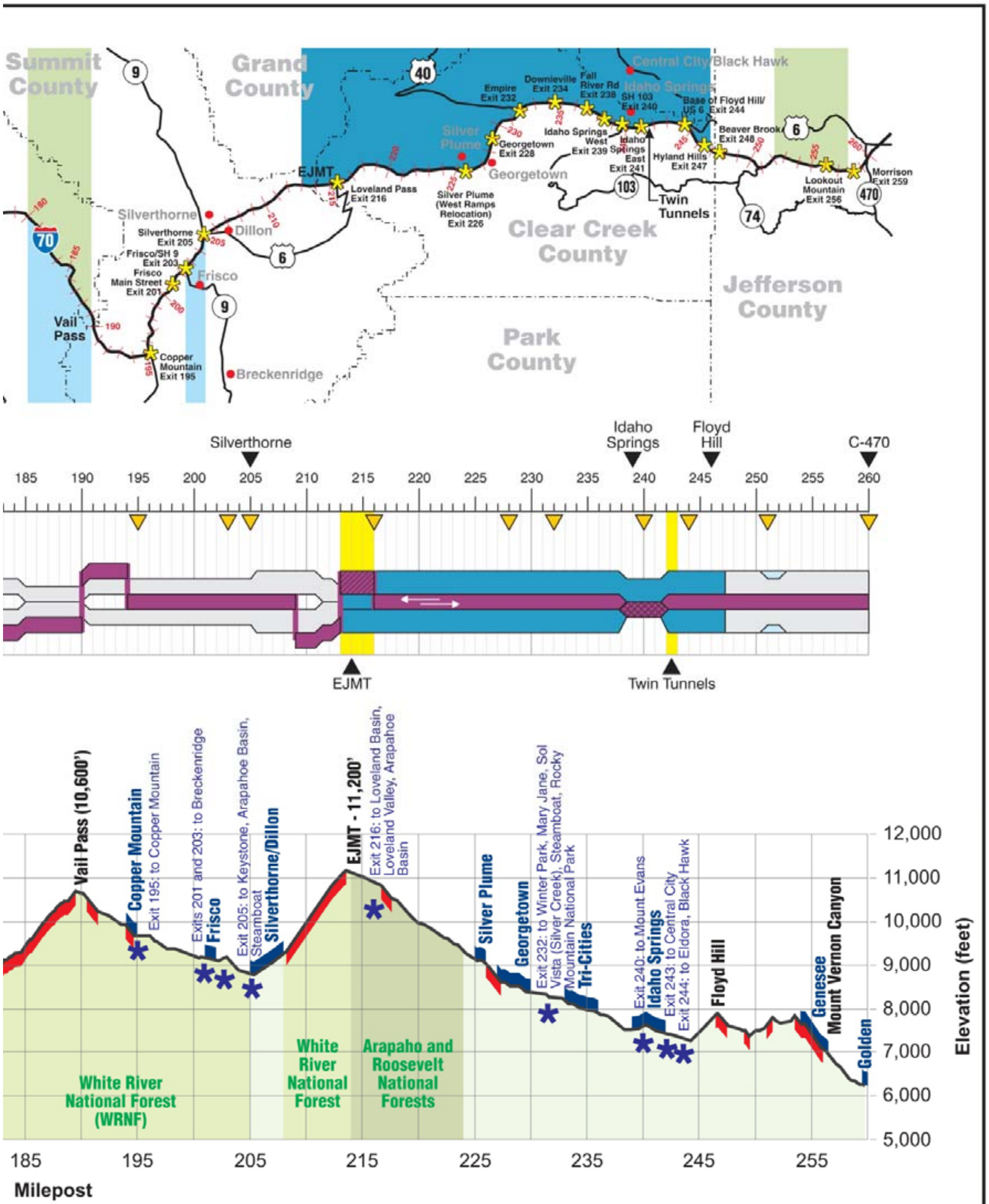


Figure 43. Preferred Alternative – Long Term – Combination 6-Lane Highway with AGS – 55 and 65 mph Options (Continued)



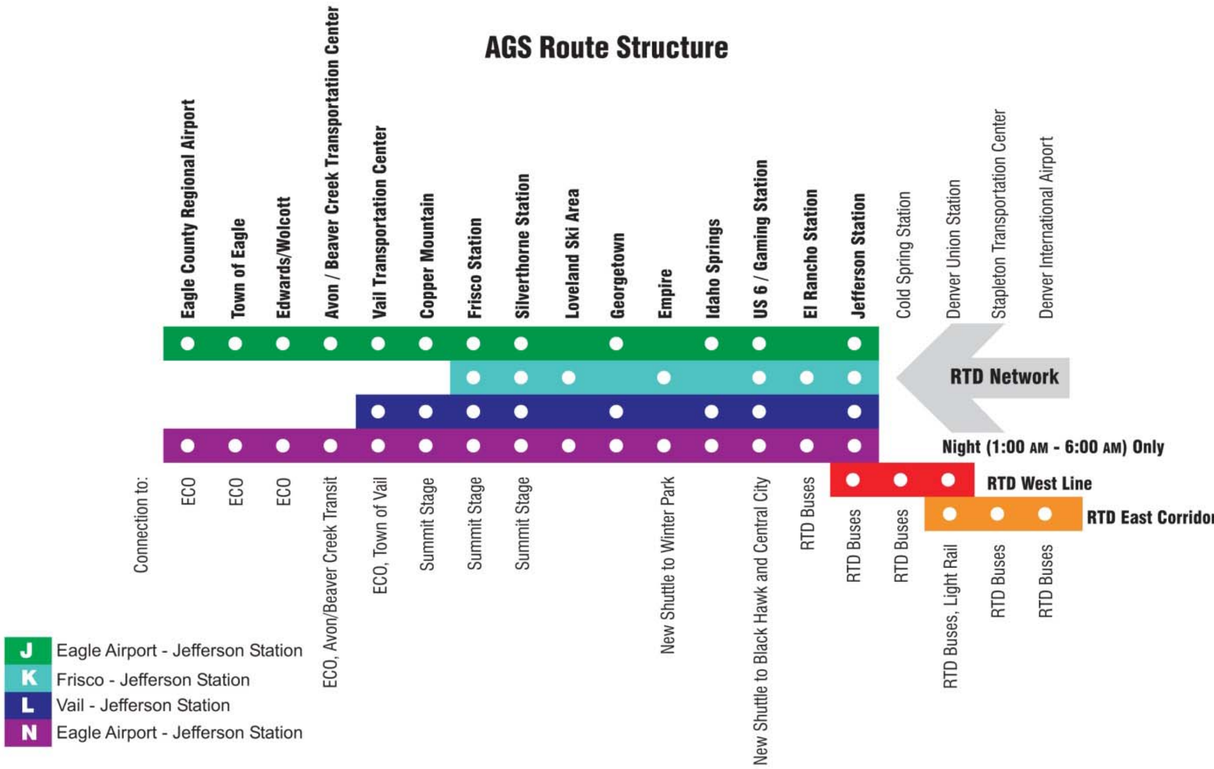
Advanced Guideway System

The Advanced Guideway System is a central part of the Preferred Alternative and includes the commitment by the lead agencies to evaluate and implement an Advanced Guideway System within the Corridor (see **Figure 44**). The evaluation includes a vision of transit connectivity beyond the study area and local accessibility to such a system. At this Tier 1 level, the Advanced Guideway System represents a mode encompassing a range of technologies, not a specific technology. A specific Advanced Guideway System technology would be determined in subsequent study or a Tier 2 document. The Colorado Department of Transportation commits to provide funding for studies to determine the viability, including cost and benefits, safety, reliability, environmental impacts, technology, and other considerations of an Advanced Guideway System. These studies would involve the Collaborative Effort stakeholder committee and follow the I-70 Mountain Corridor Context Sensitive Solutions process.

Figure 44. Example Advanced Guideway System

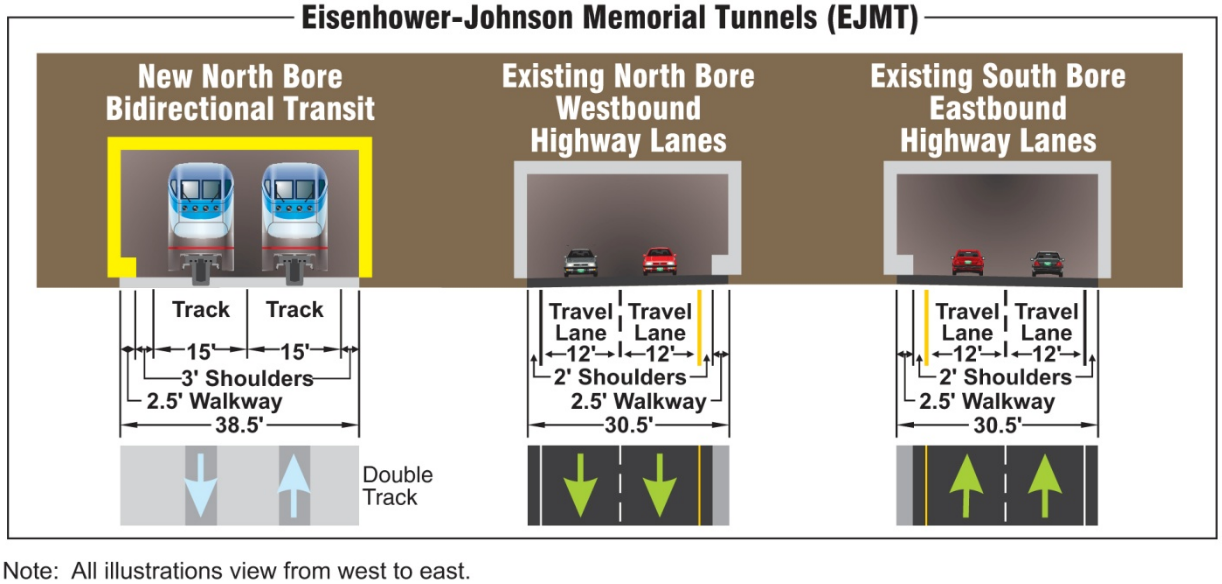
The Advanced Guideway System provides transit service from the Eagle County Regional Airport to C-470, a distance of approximately 118 miles (see **Figure 45**). The Advanced Guideway System is a fully elevated transit system on two tracks and aligns to the north, south, or in the median of the I-70 highway. The Advanced Guideway System connects to the Regional Transportation District network in Jefferson County and local and regional transit services at most of the 15 proposed transit stations along the route.

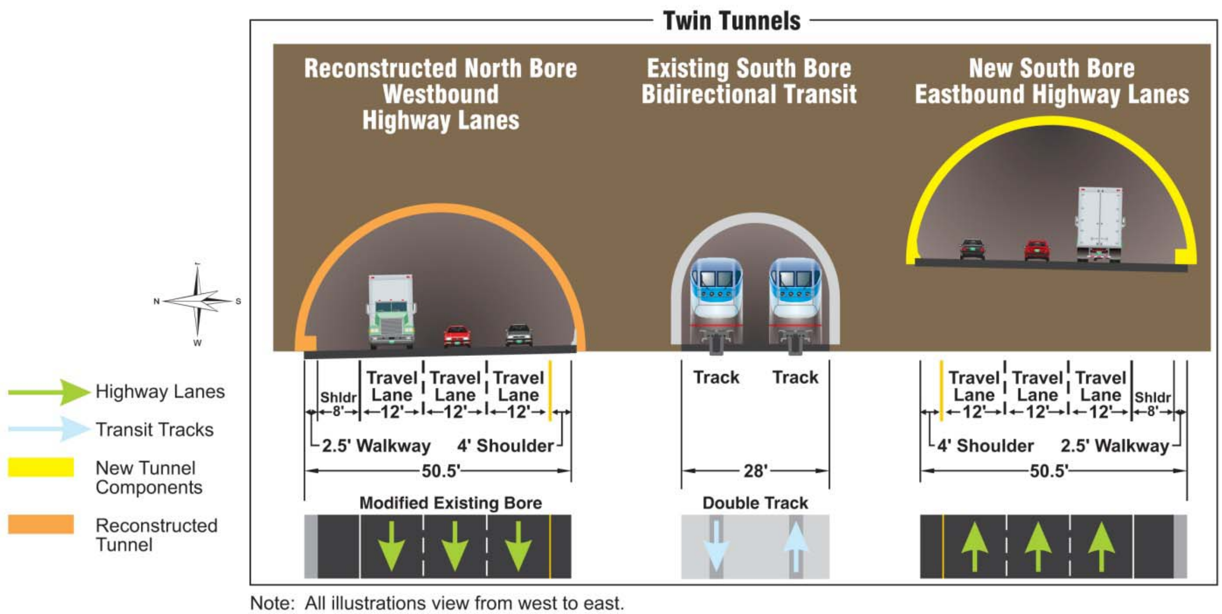
Figure 45. Advanced Guideway System Route Structure



The Advanced Guideway System requires new tunnel bores at both the Eisenhower-Johnson Memorial Tunnels and the Twin Tunnels (see **Figure 46**). At the Eisenhower-Johnson Memorial Tunnels, the proposed third tunnel bore would be located to the north of the existing tunnel bores and accommodate a bidirectional Advanced Guideway System. At the Twin Tunnels, the proposed third tunnel bore would be located to the south of the existing tunnel bores and accommodate a bidirectional Advanced Guideway System.

Figure 46. Preferred Alternative (55 and 65 mph Options) Eisenhower-Johnson Memorial Tunnels and Twin Tunnels





Highway Improvements

Additional highway improvements are needed to address current Corridor conditions and future demands. No priority has been established for improvements and those improvements must be planned considering all components of the Preferred Alternative consistent with local land use planning. The “specific” highway improvements are called out specifically as the triggers for consideration of the future highway and non-Advanced Guideway System transit capacity improvements and need to be completed before implementing any future highway and non-Advanced Guideway System transit capacity improvements. For more information on these triggers, see **Section 2.72**. The “other” highway improvements are not subject to the parameters discussed under the triggers.

Specific Highway Improvements

- Six–lane highway from Floyd Hill through the Twin Tunnels – Includes a bike trail and frontage roads from Idaho Springs to Hidden Valley and Hidden Valley to US 6
- Empire Junction (US 40/I-70) interchange improvements
- Eastbound auxiliary lane from Eisenhower-Johnson Memorial Tunnels to Herman Gulch
- Westbound auxiliary lane from Bakerville to Eisenhower-Johnson Memorial Tunnels

Other Highway Improvements

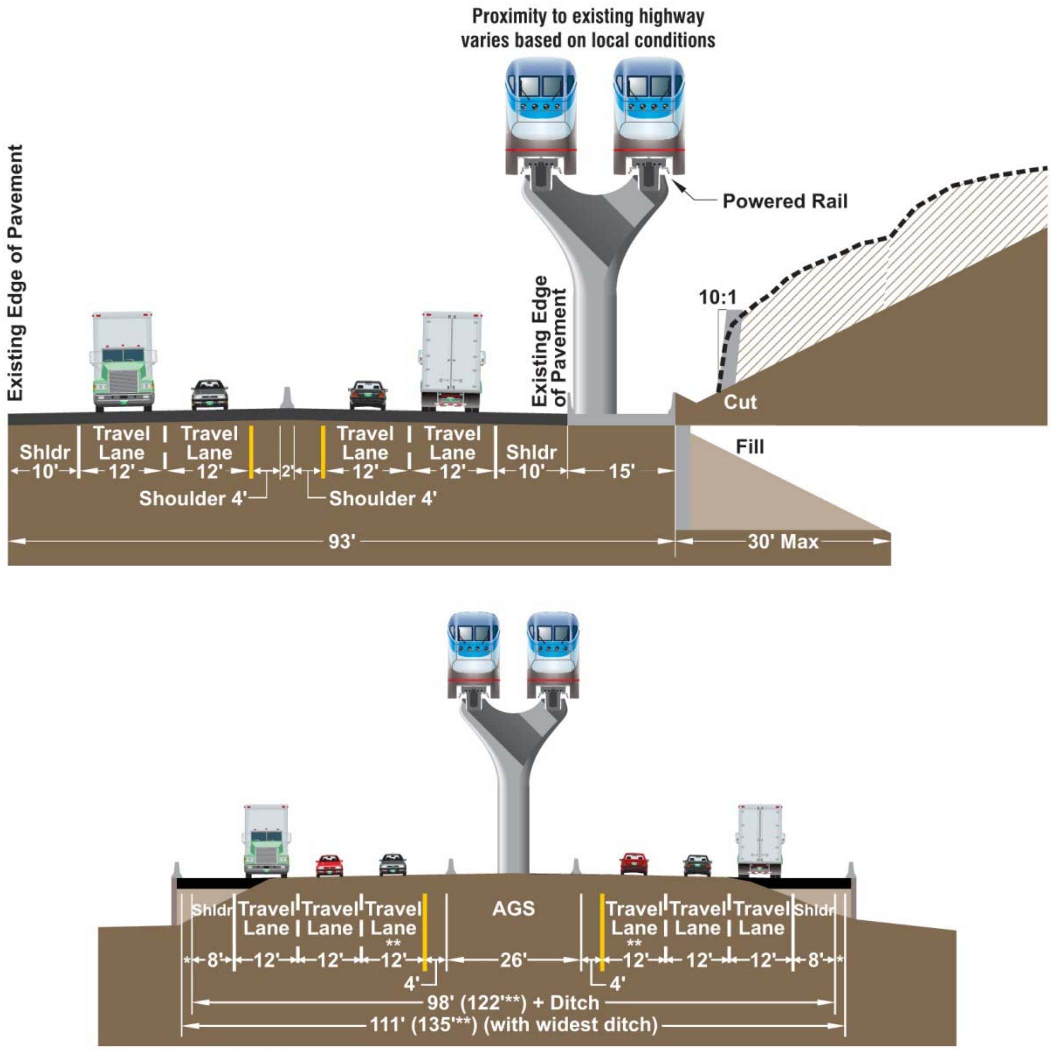
- Curve safety improvements west of Wolcott
- Safety and capacity improvements in Dowd Canyon
- Interchange improvements at the following locations:
  - Glenwood Springs
  - Gypsum
  - Eagle County Airport (as cleared by the FONSI and future 1601 process) – part of the No Action Alternative
  - Eagle and Spur Road
  - Edwards and Spur Road
  - Avon
  - Minturn
  - Vail West
  - Copper Mountain
  - Frisco/Main Street
  - Frisco/SH9
  - Silverthorne
  - Loveland Pass
  - Georgetown
  - Downieville
  - Fall River Road
  - Base of Floyd Hill/US
  - Hyland Hills
  - Beaver Brook
  - Lookout Mountain
  - Morrison

Additional Auxiliary Lanes

- Avon to Post Boulevard (Exit 168) (eastbound)
- West of Vail Pass (eastbound and westbound)
- Frisco to Silverthorne (eastbound)
- Morrison to Chief Hosa (westbound)

These improvements (non-infrastructure, Advanced Guideway System, and highway) represent the initial set of improvements and are the minimum program of improvements under the Preferred Alternative, which are expected to be implemented in the near term (see **Figure 42**). Agencies and stakeholders would review progress and effects of these improvements at least every 2 years to determine the need for additional highway and non-Advanced Guideway System transit capacity improvements. To meet the 2050 travel demand, the Preferred Alternative is equivalent to the Combination Six-Lane Highway with Advanced Guideway System Alternative, if the additional improvements are necessary. For NEPA analysis, this combination represents the maximum program of improvements and impacts under the Preferred Alternative and is analyzed in **Chapter 3** of this document. The Preferred Alternative Maximum Program comprises all of the improvements listed above and those included with the Combination Six-Lane Highway with Advanced Guideway System Alternative (see **Figure 47**).

Figure 47. Preferred Alternative Maximum Program Typical Configurations

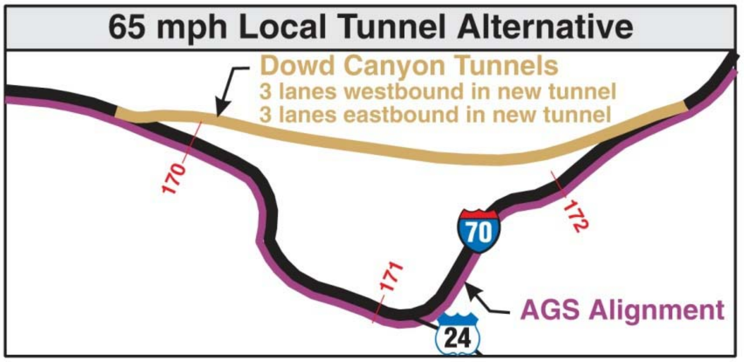


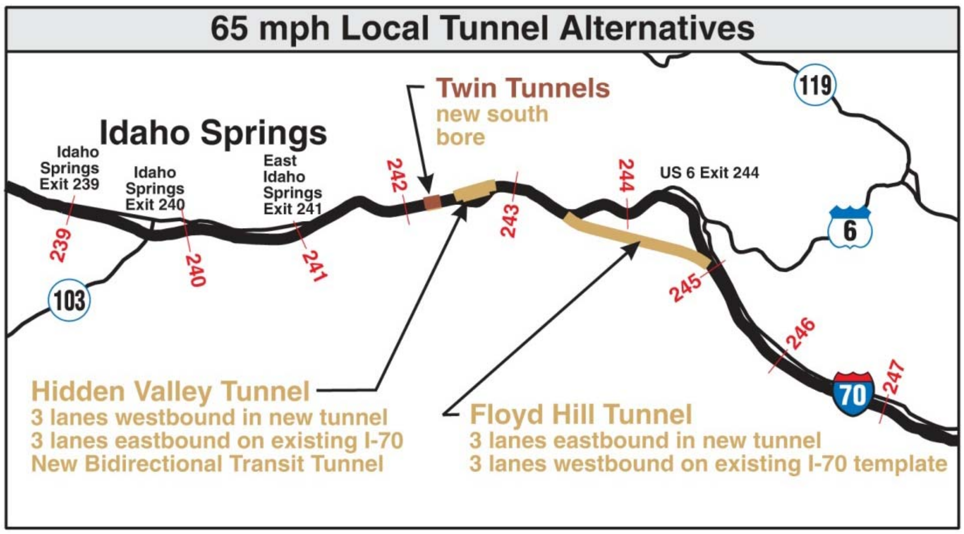
**If widened to 6-Lanes

Note: All illustrations view from west to east.

The six-lane highway widening improvements included with the Preferred Alternative Maximum Program include both 55 mph and 65 mph design options. The selected design option would be determined in Tier 2. The 55 mph option uses the existing I-70 highway alignment. The 65 mph design requires additional tunnels at Dowd Canyon, Hidden Valley, and Floyd Hill (see **Figure 48**). At Dowd Canyon, two tunnels are required for eastbound and westbound traffic as shown in **Figure 49**. These tunnels accommodate three lanes in each direction. At Hidden Valley and Floyd Hill, two new tunnels are required—one for westbound traffic just east of the Twin Tunnels near Hidden Valley and one for eastbound traffic at Floyd Hill as shown in **Figure 49.** Each of these tunnels accommodates three lanes in one direction. Traffic in the other direction uses the existing I-70 configuration.

Figure 48. Preferred Alternative (65 mph Option) Tunnel Alternative





Note: All illustrations view from west to east.

Figure 49. Preferred Alternative (65 mph Option) Dowd Canyon Tunnel, Hidden Valley Tunnel, and Floyd Hill Tunnel

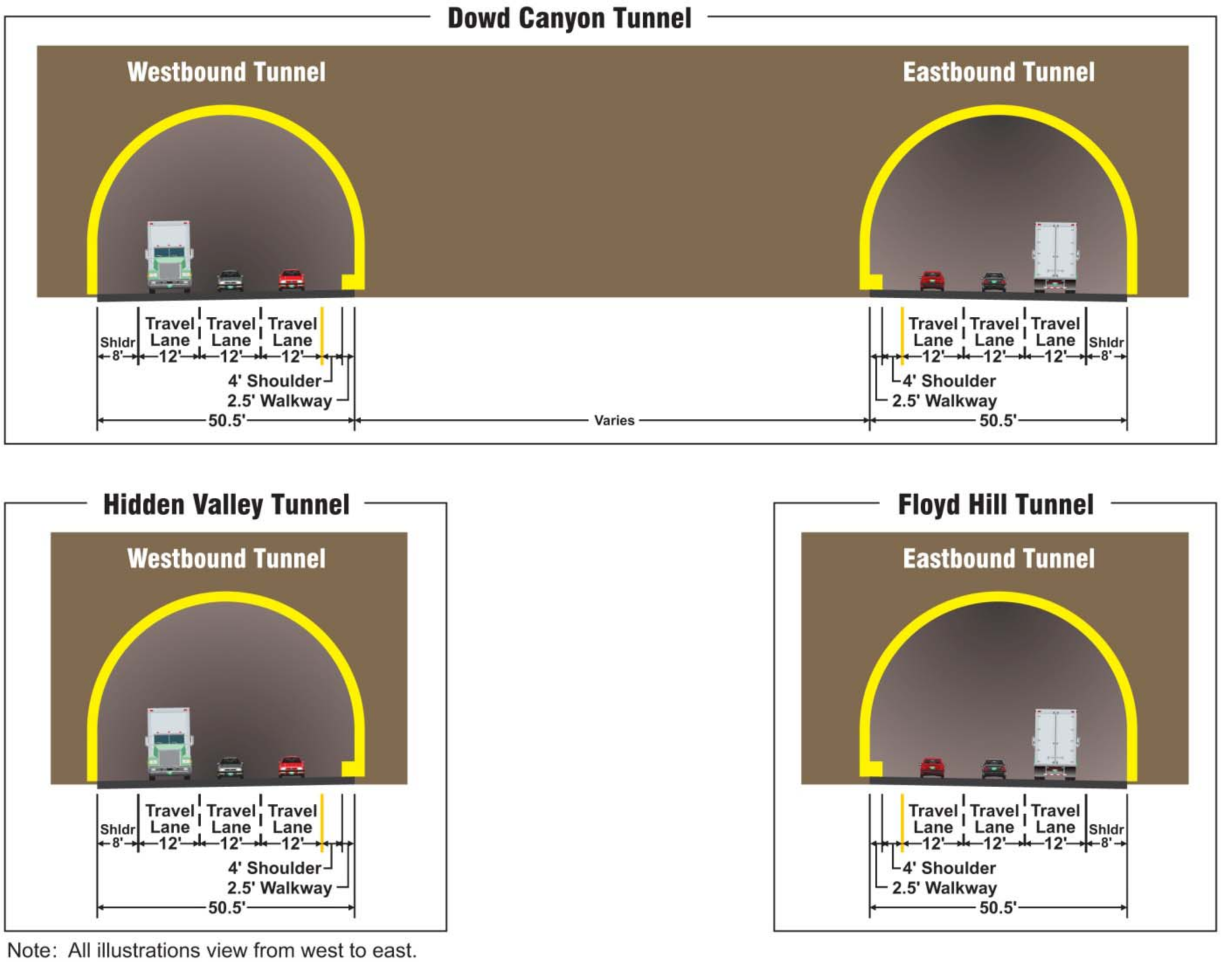


Table 15 lists and **Figure 42 and 43** illustrate the improvements associated with the Preferred Alternative.

Table 15. Components of Preferred Alternative

Transportation Components	Preferred Alternative			
	Minimum Program 55 mph	Minimum Program 65 mph	Maximum Program 55 mph	Maximum Program 65 mph
Transportation Management				
Transportation Management				
Advanced Guideway System				
Advanced Guideway System (MP 142–MP 260)				
Highway Improvements				
Specific Highway Improvements				
Six-Lane Highway Floyd Hill through Twin Tunnels with Bike Trail and Frontage Roads from Idaho Springs to Hidden Valley to US 6				
Empire Junction Interchange (MP 232)				
EB Auxiliary Lane – EJMT to Herman Gulch				
WB Auxiliary Lane – Bakerville to EJMT				
Other Highway Improvements – Interchanges				
Glenwood Springs (MP 116)				
Gypsum (MP 140)				
Eagle County Airport (part of No Action)				
Eagle & Spur Road (MP 147)				
Edwards & Spur Road (MP 163)				
Avon (MP 167)				
Minturn (MP 171)				
Vail West (MP 173) / Simba Run				
Copper Mountain (MP 195)				
Frisco / Main St. (MP 201)				
Frisco / SH 9 (MP 203)				
Silverthorne (MP 205)				
Loveland Pass (MP 216)				
Silver Plume (MP 226)				
Georgetown (MP 228)				
Downieville (MP 234)				
Fall River Road (MP 238)				
Idaho Springs West (MP 239)				
Idaho Springs / SH 103 (MP 240)				
Idaho Springs East (MP 241)				
Base of Floyd Hill / US 6 (MP 244)				

Transportation Components	Preferred Alternative			
	Minimum Program 55 mph	Minimum Program 65 mph	Maximum Program 55 mph	Maximum Program 65 mph
Hyland Hills (MP 247)				
Beaver Brook (MP 248)				
Lookout Mountain (MP 256)				
Morrison (MP 259)				
Other Highway Improvements – Curve Safety Modifications				
West of Wolcott (MP 155–MP 156)				
Dowd Canyon (MP 170–MP 173)				
Fall River Road (MP 237–MP 238)				
East of Twin Tunnels (MP 242–MP 245)	Included in Six-Lane Highway Widening			
Other Highway Improvements – Auxiliary Lanes				
Avon to Post Boulevard, Uphill (EB) (MP 167–MP 168)				
West side of Vail Pass, Downhill (WB) (MP 180–MP 190)				
West side of Vail Pass, Uphill (EB) (MP 180–MP 190)				
Frisco to Silverthorne (EB) (MP 202.7–MP 205.1)				
Morrison to Chief Hosa, Uphill (WB) (MP 253–MP 259)				
Tunnels				
Dowd Canyon				
EJMT – third bore				
Twin Tunnels – third bore				
Hidden Valley Tunnel WB				
Floyd Hill Tunnel EB				
Other Improvements				
Truck operation improvements (pullouts, parking and chain stations)				
Black Gore Creek, Straight Creek and Clear Creek Sediment Control				

Key to Abbreviations/Acronyms

EB = eastbound   EJMT = Eisenhower-Johnson Memorial Tunnels   MP = milepost   mph = miles per hour
SH = State Highway   WB = westbound

5.6 No Action Alternative

The No Action Alternative includes only ongoing highway maintenance and improvements with committed funding sources highly likely to be implemented by the 2035 planning horizon. These improvements are committed whether or not any other improvements are constructed with this I-70 Mountain Corridor project. The No Action Alternative is assessed and used as a baseline for environmental analysis and represents what would exist if no action were taken based on the NEPA process.

Figure 2-2 in Chapter 2 of the PEIS shows the No Action Alternative improvements by area. These improvements include highway improvements, park-and-ride facilities, tunnel enhancements, and general improvements.

5.6.1 Highway Improvements

Highway improvements include the following:

- **Eagle County Regional Airport Interchange** – This includes a direct connection between the Eagle County Regional Airport and I-70 located between milepost 142 and milepost 143.
- **SH 9 –** This project includes upgrading SH 9 between Frisco and Breckenridge to four lanes.
- **US 6 –** This project includes overlay and shoulder widening on US 6 between milepost 153 and milepost 158.

5.6.2 Park-and-Ride Facilities

Two locations are identified for new park-and-ride facilities:

- Silverthorne (milepost 206)
- Breckenridge (SH 9)

5.6.3 Tunnel Enhancements

Tunnel enhancements are planned for the:

- Hanging Lake Tunnel in Glenwood Canyon
- Eisenhower-Johnson Memorial Tunnels.

5.6.4 General Improvements

General improvements include the following:

- Routine safety
- Resurfacing
- Bridge repairs
- Other maintenance activities
- Sediment control

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Appendices

This Section is a description of the Appendices.

Appendices can be viewed in a seperate file that can be accessed through the Volume 2 menu.

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Ten appendices support the *I-70 Mountain Corridor PEIS Alternatives Development and Screening Technical Report*:

- **Appendix A** describes the transportation management alternative elements considered for the *I-70 Mountain Corridor PEIS*. It presents an overview of Corridor problems (consistent with the purpose and need, as described in **Chapter 1** of the PEIS), provides an overview of comparable North American case studies and best practices, and describes and assesses specific transportation management strategies for the Corridor. The report was prepared by URBANTRANS in 2003 and remains a valid assessment of Corridor transportation management strategies. The case studies and ideas presented continue to be relevant strategies that could be implemented in the Corridor. Because the I-70 highway has not undergone any major changes, CDOT has not implemented any of the strategies outlined in the report, and the report assesses a broad range of strategies, the 2003 report has not been updated but remains valid.
- **Appendix B** describes the transit alternative elements considered for the *I-70 Mountain Corridor PEIS*. It provides the introduction to the transit families for Rubber Tire Transit and Fixed Guideway Transit. It discusses the characteristics of each technology type and provides background to the capabilities of the technologies to operate in the Corridor. It was prepared in 2000 when the transit alternative elements were first being considered. Although old, the report describes the initial constraints of the technologies and is contemporary to the screening processes and decisions ongoing during this timeframe.
- **Appendix C** provides more detailed data for the transit alternative elements considered for the I-70 Mountain Corridor PEIS. It presents train performance modeling results from the RAILSIM model and assesses the model results with the criteria for Level 2 screening. In addition, this report provides a conceptual operating plan for both Rubber Tire and Fixed Guideway Transit. The report was prepared in 2001 and is contemporary to the screening decisions that were occurring during that timeframe. As such, the 2001 information documents the decisions that occurred early in the process and remains valid.
- **Appendix D** discusses limitations of Fixed Guideway Transit systems to operating on steep mountain grades. It describes theoretical design issues as well as empirical examples of systems worldwide. It does not assess technologies that have developed or been implemented since the report was prepared. The PEIS notes updates in system technologies and acknowledges that technological advances will need to be revisited in Tier 2 processes. The information presented in Appendix D is old and would need to be updated in Tier 2 studies but is helpful to provide context to decisions being made during the screening process.
- **Appendix E** provides a summary of the Level 1 and Level 2 screening processes and presents refined data about transit performance to support Level 3 screening. It also presents rationale for initial footprints of transit alternative elements. Although the alternatives advanced for discussion in the PEIS continued to be refined and, in this way the information presented in Appendix E is out of date, the report provides documentation about how alternatives were developed and the decision making that supported the advancement of alternatives to the PEIS. The PEIS contains current discussion of the alternative footprints.
- **Appendix F** presents results of Level 2 screening for transit and highway alternatives. In addition to describing the screening criteria and evaluation results, it presents a summary of environmental impacts for each alternative. The environmental impact information has been updated in the PEIS but the discussion of the screening process remains valid documentation of the decision making processes that resulted in the range of alternatives that are evaluated in the PEIS.
- **Appendix G** discusses air service characteristics and operational inventory of airports in and serving the Corridor. The information supports the evaluation and screening of aviation improvements as a family of alternatives that could be considered to relieve I-70 highway

congestion. Although the report was prepared early in the PEIS process, the information remains valid because neither vehicular nor air travel conditions in the Corridor have changed enough to change the assessment of aviation alternatives. Additionally, the aviation elements fall well short of meeting I-70 highway needs, which reinforces the decision not to update data or reconsider aviation elements.

- **Appendix H** presents an assessment of how many automobile trips could be diverted by aviation improvements. The conclusion that an estimated 50 to 100 trips per day might be diverted by improvements to west slope airports reinforces the conclusions in **Appendix G** that aviation improvements would have little effect on I-70 congestion. As with **Appendix G**, updating the information is not worthwhile even if the trips doubled, tripled, or more, the aviation elements would still have little to no effect on I-70 highway congestion.
- **Appendix I** discusses the development, evaluation, and screening of alternate routes to the I-70 highway. The report was prepared in 2000. Because no major changes to the I-70 highway or the alternate routes evaluated have occurred since that time, the analyses remains valid, especially for comparison of alternatives at a Tier 1 level.
- **Appendix J** discusses the Level 1 screening process. The report was prepared in 2000 and represents documentation of decisions made during that timeframe.