Little Cottonwood Canyon ENVIRONMENTAL IMPACT STATEMENT
S.R. 210 | Wasatch Blvd. to Alta

Draft Alternatives Development and Screening Report

Little Cottonwood Canyon Environmental Impact Statement S.R. 210 – Wasatch Boulevard to Alta

Utah Department of Transportation

June 8, 2020

Executive Summary

This report summarizes and presents the results of the alternatives development and screening process for the Little Cottonwood Canyon Environmental Impact Statement (EIS). The study area for the transportation needs assessment used for the State Route (S.R.) 210 Project extends along S.R. 210 from its intersection with S.R. 190/Fort Union Boulevard in Cottonwood Heights, Utah, to its terminus in the town of Alta, Utah, and includes the Bypass Road.

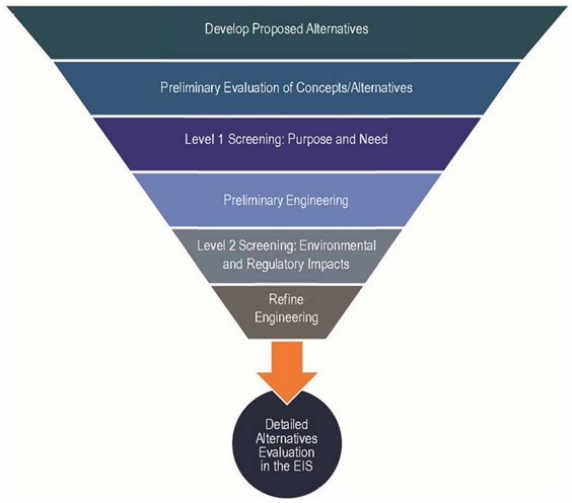
The alternatives development and screening process described in this report provided critical information about how well an alternative would satisfy the purpose of and need for the S.R. 210 Project and whether it is reasonable and practicable. The criteria used in both the first- and second-level screening analyses generated measures that allowed the Utah Department of Transportation (UDOT) to systematically and objectively identify reasonable alternatives and screen out unreasonable alternatives. The entire process took place over several months and considered agency and public input.

The environmental review, consultation, and other actions required by applicable federal environmental laws for this action are being, or have been, carried out by UDOT pursuant to 23 United States Code (USC) Section 327 and a Memorandum of Understanding dated January 17, 2017, and executed by the Federal Highway Administration and UDOT.

Results of the Screening Process

UDOT conducted a three-level screening evaluation of alternatives suggested by stakeholders and in previous studies, as shown in Figure 1-1. The evaluation started with a preliminary evaluation of alternatives to determine whether they were feasible to be considered further in Level 1 screening. If an alternative was determined to be feasible, it was further developed so that Level 1 screening could be conducted.

Figure 1-1. Screening Process Overview



Level 1 screening was based on the project purpose to substantially improve safety, reliability, and mobility on S.R. 210 from Fort Union Boulevard through the town of Alta for all users on S.R. 210. In this report, *reliability* refers to closure of S.R. 210 from avalanches and avalanche mitigation, and *mobility* refers to travel time and vehicle backups caused by congestion. The alternatives that passed Level 1 screening were then evaluated with Level 2 screening in terms of their expected impacts to the natural and built environment.

The alternatives were screened with regard to the following project purpose elements:

- **Improve mobility on S.R. 210:**
  - Mobility on Wasatch Boulevard
  - Mobility on S.R. 210 from Fort Union Boulevard to Alta
- **Improve reliability and safety on S.R. 210:**
  - Avalanche mitigation
  - Trailhead parking
  - Winter roadside parking

What are mobility and reliability?

In this report, *mobility* refers to travel time and vehicle backups caused by congestion, and *reliability* refers to closure of S.R. 210 from avalanches and avalanche mitigation.

Based on the screening process, the following alternative options (designated with square bullets) passed both Level 1 and Level 2 screening:

- **Improve mobility on S.R. 210:**
  - Mobility on Wasatch Boulevard:
    - Imbalanced-lane alternative
    - Five-lane alternative
  - Mobility on S.R. 210 from Fort Union Boulevard to Alta:
    - Enhanced bus service with no widening of S.R. 210 in Little Cottonwood Canyon (24 buses per hour during the peak period)
    - Enhanced bus service in peak-period shoulder lanes on S.R. 210 in Little Cottonwood Canyon (24 buses per hour during the peak period)
    - Gondola with enhanced bus service
- **Improve reliability and safety on S.R. 210:**
  - Avalanche mitigation:
    - Snow sheds with guiding berms
    - Snow sheds and realigned road with no guiding berms
  - Trailhead parking:
    - Trailhead parking improvements with no roadside parking within ¼ mile
    - Trailhead parking improvements with no roadside parking from canyon entrance to Snowbird Entry 1
    - No trailhead parking improvements with no roadside parking from canyon entrance to Snowbird
  - Winter roadside parking:
    - Elimination of winter roadside parking on S.R. 210 adjacent to the ski resorts

Alternatives Advanced for Further Evaluation in the Draft EIS

To conduct the analysis of the effects of the alternative options on the human and natural environment, UDOT packaged the alternative options into three main alternatives with options to ensure that each alternative met the project purpose of improving safety, reliability, and mobility. These three action alternatives presented in Table S-1.

After the impact evaluation is performed, UDOT will review the information and identify a preferred alternative in the Draft EIS from the three alternatives listed in Table S-1. The preferred alternative will include a selection of which options for each element (Wasatch Boulevard, S.R. 210, Avalanche Mitigation, Trailhead Parking, and Winter Roadside Parking) UDOT prefers.

Table S-1. Alternatives and Options To Be Evaluated in the Draft EIS

Alternative	Purpose Element and Associated Options				
	Purpose Element: Improve Mobility		Purpose Element: Improve Reliability and Safety		
	Wasatch Boulevard Options	S.R. 210 from Fort Union Boulevard to Alta Options	Avalanche Mitigation Options	Trailhead Parking Options	Winter Roadside Parking Options
Enhanced Bus Service with No Widening of S.R. 210 in Little Cottonwood Canyon Alternative	• Imbalanced-lane Alternative • Five-lane Alternative	**Enhanced bus service with mobility hubs at the gravel pit[a] and 9400 South/Highland Drive** • Winter point-to-point bus service from each mobility hub directly to the ski resorts[b] • 24 buses per hour in the peak hour • About 1,008 people on buses in the peak hour • 2,500 new parking spaces divided between two mobility hubs at the gravel pit and 9400 South and Highland Drive • Bus priority on Wasatch Boulevard • Tolling or other management strategies such as no single-occupant vehicles during peak periods	• Snow sheds with berms • Snow sheds and realigned road with no berms	• Trailhead parking improvements with no roadside parking within ¼ mile • Trailhead parking improvements with no roadside parking from canyon entrance to Snowbird Entry 1 • No trailhead parking improvements with no roadside parking from canyon entrance to Snowbird	• Elimination of winter roadside parking on S.R. 210 adjacent to the ski resorts
Enhanced Bus Service in Peak-period Shoulder Lanes on S.R. 210 in Little Cottonwood Canyon Alternative	• Imbalanced-lane Alternative • Five-lane Alternative	**Enhanced bus service with mobility hubs at the gravel pit[a] and 9400 South/Highland Drive** • Winter point-to-point bus service from each mobility hub directly to the ski resorts[b] • 24 buses per hour in the peak hour • About 1,008 people on buses in the peak hour • 2,500 new parking spaces divided between two mobility hubs at the gravel pit and 9400 South and Highland Drive • Bus priority on Wasatch Boulevard • Tolling or other management strategies such as no single-occupant vehicles during peak periods • Winter bus only peak-period shoulder lanes from the North Little Cottonwood Road/Wasatch Boulevard intersection to the Alta Bypass Road; peak-period shoulder lanes would be cyclist and pedestrian facilities in summer	• Snow sheds with berms • Snow sheds and realigned road with no berms	• Trailhead parking improvements with no roadside parking within ¼ mile • Trailhead parking improvements with no roadside parking from canyon entrance to Snowbird Entry 1 • No trailhead parking improvements with no roadside parking from canyon entrance to Snowbird	• Elimination of winter roadside parking on S.R. 210 adjacent to the ski resorts
Gondola Alternative	• Imbalanced-lane Alternative • Five-lane Alternative	**Gondola from the entrance of Little Cottonwood Canyon to Alta Ski Resort** • Winter gondola service starting at the gondola platform at the entrance of Little Cottonwood Canyon with stops at Snowbird ski resort and Alta ski resort only[b] • About 30 gondola cabins per hour • About 1,050 people on gondolas in the peak hour • 2,500-space parking structure at the gravel pit • Enhanced bus service from the gravel pit to the gondola loading platform at the entrance of Little Cottonwood Canyon (there would be no parking at the gondola platform) • Bus priority on Wasatch Boulevard • Tolling or other management strategies such as no single-occupant vehicles during peak periods	• None; gondola could be used when S.R. 210 is closed for avalanche mitigation, similar to existing conditions	• Trailhead parking improvements with no roadside parking within ¼ mile • Trailhead parking improvements with no roadside parking from canyon entrance to Snowbird Entry 1 • No trailhead parking improvements with no roadside parking from canyon entrance to Snowbird	• Elimination of winter roadside parking on S.R. 210 adjacent to the ski resorts

[a] The gravel pit is located on the east side of Wasatch Boulevard between 6200 South and Fort Union Boulevard.
[b] The purpose of the project is to improve winter mobility. Screening criteria did not evaluate the performance of summer service.

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Abbreviations and Acronyms

1S	mono-cable gondola system
2S	bi-cable gondola system
3S	tri-cable gondola system
AHI	avalanche hazard index
AM	morning
CFR	Code of Federal Regulations
D.A.V.E.	Dual-mode Advanced Vehicular Endeavor
EIS	Environmental Impact Statement
FHWA	Federal Highway Administration
GIS	geographic information systems
HOV	high-occupancy vehicle
i.e.	that is
I-15	Interstate 15
I-215	Interstate 215
LOS	level of service
MUTCD	*Manual on Uniform Traffic Control Devices*
NA	not applicable
NEPA	National Environmental Policy Act
NFS	National Forest System
O&M	operation and maintenance
OD	origin-destination (study)
PM	afternoon
PPSL	peak-period shoulder lane
RTP	*Wasatch Front Regional Transportation Plan*
S.R.	state route
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
Section 4(f)	Section 4(f) of the Department of Transportation Act of 1966
Section 6(f)	Section 6(f) of the Land and Water Conservation Fund Act of 1965
SPT	Little Cottonwood Canyon Sketch Planning Tool
UDOT	Utah Department of Transportation
USC	United States Code
USDA	U.S. Department of Agriculture
USDOT	United States Department of Transportation
UTA	Utah Transit Authority
WFRC	Wasatch Front Regional Council

1.0 Introduction

1.1 Report Purpose and Background Information

This summarizes and presents the results of the alternatives development and screening process for the Little Cottonwood Canyon Environmental Impact Statement (EIS). The study area for the transportation needs assessment used for the State Route (S.R.) 210 Project extends along S.R. 210 from its intersection with S.R. 190/Fort Union Boulevard in Cottonwood Heights, Utah, to its terminus in the town of Alta, Utah, and includes the Bypass Road (Figure 1-1). UDOT developed this study area to include an area that is influenced by the transportation operations in Little Cottonwood Canyon and to provide logical termini for the project. The transportation needs assessment study area is used only to determine the need for transportation solutions. Separate impact analysis areas will be developed for each environmental resource evaluated in this EIS to assess direct, indirect, and cumulative impacts to those resources.

The intersection of S.R. 210 with S.R. 190/Fort Union Boulevard was selected as the western terminus because it is the point where traffic splits between Big Cottonwood Canyon and Little Cottonwood Canyon. Traffic south of this intersection is mostly related to trips into and out of Little Cottonwood Canyon and commuter traffic on Wasatch Boulevard. The end of the paved road in Little Cottonwood Canyon was selected as the eastern terminus because this is where S.R. 210 terminates in the town of Alta at Albion Basin Road. The project does not include Albion Basin Road.

The study area also includes the S.R. 210 Bypass Road. The Bypass Road was included in the evaluation because it functions as an alternate route when S.R. 210 is closed for avalanche control.

Through the study area, S.R. 210 is designated with different street names. For clarity in this report, the following segments of S.R. 210 use the following naming conventions (shown in Figure 1-1):

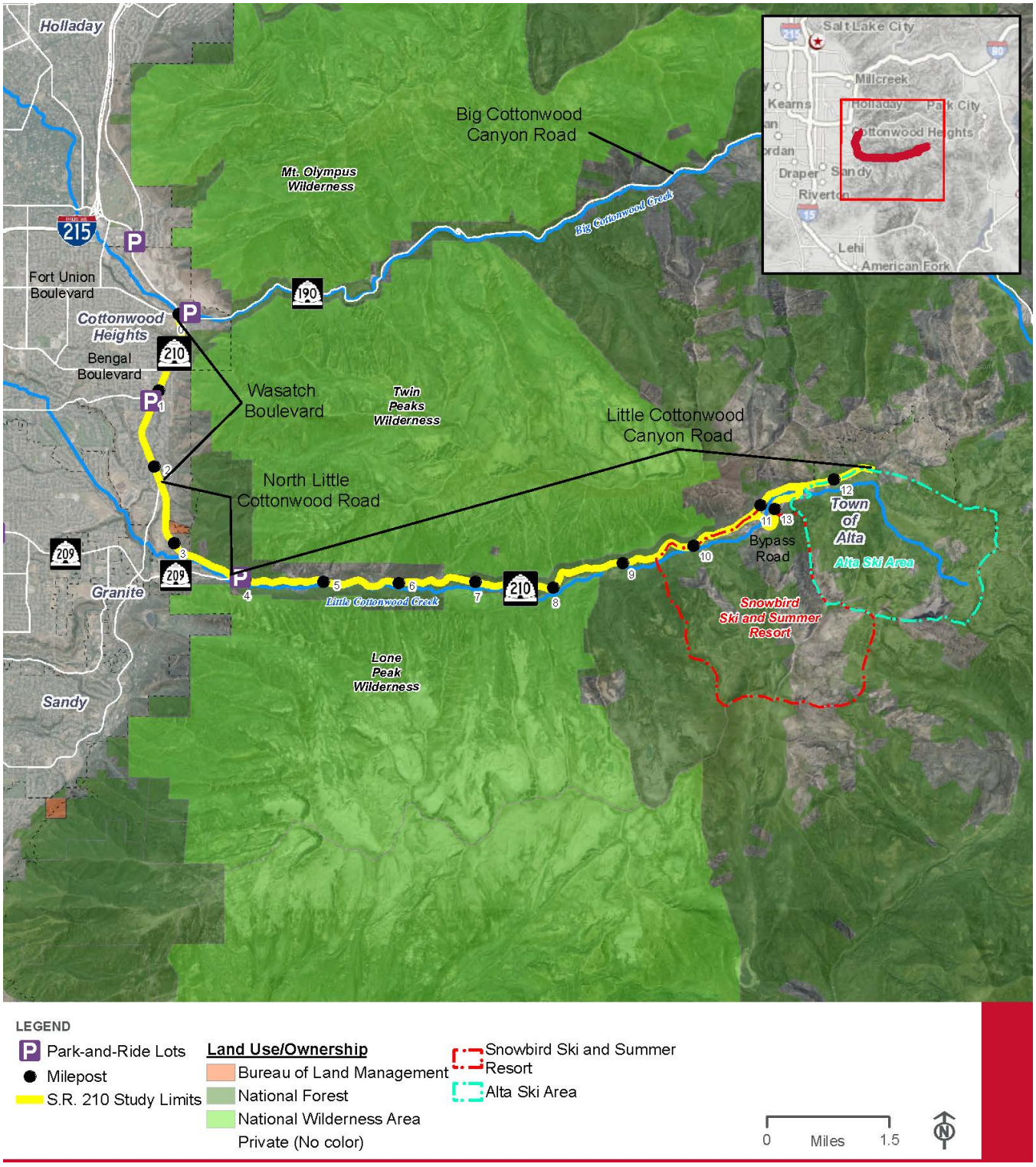
- **Wasatch Boulevard** – S.R. 210 from Fort Union Boulevard to North Little Cottonwood Road
- **North Little Cottonwood Road** – S.R. 210 from Wasatch Boulevard to the intersection with S.R. 209
- **Little Cottonwood Canyon Road** – S.R. 210 from the intersection of North Little Cottonwood Road and S.R. 209 through the town of Alta, including the Bypass Road, up to but not including Albion Basin Road

The alternatives development and screening process described in this report provided critical information about how well an alternative would satisfy the purpose and need for the S.R. 210 Project and whether it is reasonable and/or technically feasible. The criteria used in both the first- and second-level screening analyses generated measures that allowed the Utah Department of Transportation (UDOT) to systematically and objectively identify reasonable alternatives and screen out unreasonable alternatives. The entire process took place over several months and considered agency and public input.

This report provides UDOT's preliminary evaluation of the alternatives development and screening process. As UDOT receives input from the public and agencies during the EIS process, the results of this process might be modified.

The environmental review, consultation, and other actions required by applicable federal environmental laws for this action are being, or have been, carried-out by UDOT pursuant to 23 United States Code (USC) 327 and a Memorandum of Understanding dated January 17, 2017, and executed by the Federal Highway Administration (FHWA) and UDOT.

Figure 1-1. Transportation Needs Assessment Study Area for the S.R. 210 EIS



1.2 Summary of the Project Purpose and Need

The first level of screening, and the primary criterion for determining whether an alternative is reasonable and practicable, is whether the alternative reasonably meets the purpose of and need for the project. For the S.R. 210 Project, UDOT's purpose is reflected in one primary objective for S.R. 210:

- Substantially improve transportation related safety, reliability, and mobility on S.R. 210 from Fort Union Boulevard through the town of Alta for all users on S.R. 210.

The transportation needs in the study area are related primarily to traffic during peak periods, avalanche risk and avalanche control in Little Cottonwood Canyon, multiple roadside users in constrained areas, and anticipated future increases in visitation to Little Cottonwood Canyon as a result of population growth in Utah. The following deficiencies occur in the study area:

- Decreased mobility in winter during the morning (AM) and afternoon (PM) peak travel periods related to visits to ski areas, with the greatest traffic volumes on weekends and holidays and during and after snowstorms.
- Decreased mobility on Wasatch Boulevard resulting from weekday commuter traffic.
- Safety concerns associated with avalanche hazard and traffic delays caused by the current avalanche-control program in Little Cottonwood Canyon. Periodic road closures for avalanche control can cause 2-to-4-hour travel delays or longer, which can cause traffic to back up in the neighborhoods around the entrance of the canyon and often stretching to Interstate 215 (I-215).
- Limited parking at trailheads and ski areas that leads to roadside parking. The consequences of roadside parking include:
  - Reduced mobility on S.R. 210 near trailheads and at ski areas
  - Loss of shoulder area for cyclists and pedestrians, which forces them into the roadway travel lane and creates a safety concern
  - Creation of informal trailheads that contribute to erosion, mineral soil loss, the spread of invasive weeds, watershed degradation, and loss of native vegetation in the canyon
  - Damage to the pavement along the roadway edge, which causes increased soil erosion, runoff into nearby streams, and watershed degradation

What are peak periods?

Peak periods are the periods of the day with the greatest amounts of traffic. For Little Cottonwood Canyon, the winter daily peak periods are tied to the ski areas opening and closing, whereas peak summer traffic occurs in the early afternoon. Peak periods are looked at by transportation analysts when examining the need for a project.

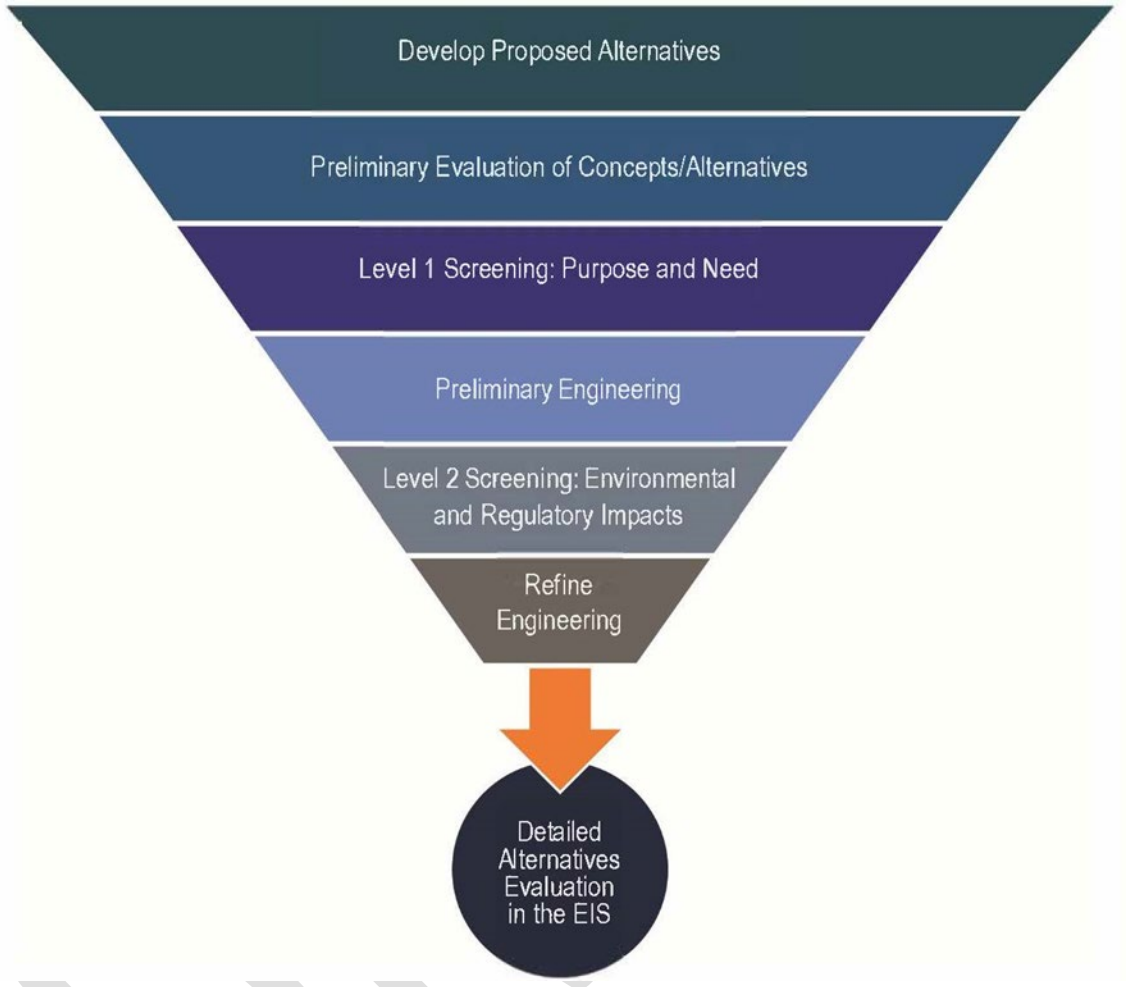
In this report, *reliability* refers to closure of S.R. 210 from avalanches and avalanche mitigation, and *mobility* refers to travel time and vehicle backups caused by congestion.

1.3 Screening Process Overview

The alternatives development and screening process consisted of the following phases (Figure 1-2):

1. Develop proposed alternatives that respond to the Purpose and Need Statement based on previous studies, public and agency input during the scoping process, and local and regional land use and transportation plans.
2. Conduct a preliminary evaluation of general concepts and/or alternatives received during the EIS scoping process to determine which concepts and/or alternatives could generally meet the project purpose, are within the scope of the EIS and EIS study area, and are technically feasible (for more information, see Section 1.3.2, Preliminary Evaluation of Concepts and Alternatives). The alternatives that were not eliminated during the preliminary evaluation were carried forward into Level 1 screening.
3. Apply initial (Level 1) screening criteria to eliminate alternatives that do not meet the purpose of and need for the project.
4. Refine alternatives that pass the Level 1 screening process.
5. Apply secondary (Level 2) screening criteria to eliminate alternatives that might meet the purpose of and need for the project but would be unreasonable alternatives for other reasons—for example, an alternative would have unreasonable impacts to the natural and human environment, would not meet regulatory requirements, or could be replaced by a less costly alternative with similar impacts to the natural and human environment.
6. Conduct preliminary engineering. The alternatives that pass Level 1 and Level 2 screening will be further developed to avoid and minimize impacts to the natural and human environment and designed to a higher level of detail before UDOT performs the detailed impact analyses for the EIS.

Figure 1-2. Overview of the Little Cottonwood Canyon EIS Alternatives Development and Screening Process



The alternatives development and screening process is designed to be dynamic throughout the EIS process. If a new alternative is developed later in the process, it will be subject to the same screening process as all of the other alternatives, as described in this report. The results of the screening process are presented in this report and will be summarized in the EIS. All proposed alternatives were developed to an equal level of detail at each screening level to allow for objective screening.

1.3.1 Development of Proposed Alternatives

The first phase in the alternatives development and screening process was identifying a list of preliminary alternatives. To be considered a preliminary alternative, an alternative had to be applicable to the study area and had to present a type of solution that could potentially meet the project's purpose and basic transportation needs. For example, an alternative had to be compatible with the area's topography, climate, and available technology and had to be potentially capable of addressing mobility, reliability, and safety challenges, especially during peak travel periods.

The preliminary alternatives were developed based on previous planning studies and through the EIS agency and public scoping process. These alternatives were developed with input from existing land use and transportation plans, the public, local municipal governments, and resource agencies. The input was collected during the EIS public scoping periods (initial scoping period March 9 to May 4, 2018, and revised scoping period March 5 to June 14, 2019), at agency scoping meetings (April 9, 2018, and April 3, 2019), and in stakeholder interviews. In addition, a report describing the screening process that would be used (*Draft Alternatives Development and Screening Methodology and Preliminary Concept Report*) was placed on the project website (on November 4, 2019) and provided to the public and cooperating and participating agencies for a 40-day public comment period. During that review period, additional alternative concepts were provided to UDOT to consider.

1.3.1.1 Previous Studies and Plans

The Little Cottonwood Canyon EIS team considered alternatives from the following previous transportation studies:

- Mountain Accord Process
- *Mountain Transportation Study Final Report* (Fehr & Peers 2012)
- *Cottonwood Heights General Plan* (City of Cottonwood Heights 2005)
- *Cottonwood Canyons Scenic Byways Corridor Management Plan* (Fehr & Peers 2008)
- *Wasatch Boulevard Master Plan* (City of Cottonwood Heights 2019)

1.3.1.2 Scoping

As discussed in the *Little Cottonwood Canyon EIS Scoping Summary Report*, during the EIS scoping process in 2018 and 2019, UDOT received more than 1,500 comments, about 100 of which suggested concepts and alternatives for UDOT to evaluate in the EIS. These 100 comments addressed alternative locations, alternative configurations, travel modes, safety, construction costs, construction methods, and logical termini. Where applicable, the Little Cottonwood Canyon EIS team incorporated the alternatives scoping comments when developing the range of preliminary alternatives. For more information, see Section 1.3.2, Preliminary Evaluation of Concepts and Alternatives.

1.3.1.3 Meetings with Stakeholders

During the development of alternatives, UDOT held numerous meetings with stakeholders to receive input on potential alternatives to consider. Meetings were held with the Salt Lake Climbers Alliance on May 1, 2019; with the Granite Community Council on April 10, 2019; and with the following city and county councils:

- City of Cottonwood Heights, April 2, 2019
- Town of Alta, April 11, 2019
- Sandy City, April 23, 3019
- Salt Lake County, June 11, 2019

Additionally, a 40-day review period (from November 4, 2019, to December 13, 2019) was provided for stakeholder comments on the preliminary alternatives development and alternatives screening criteria. During this comment period, the following meetings were held with stakeholders:

- Central Wasatch Commission, November 4, 2019
- Granite Community Council, November 6, 2019
- Save Our Canyons, November 13, 2019
- Town of Alta Council, November 13, 2019
- Cottonwood Heights residents, November 13 and 15, 2019
- Central Wasatch Commission staff, November 18, 2019
- Granite Community residents, November 18, 2019
- Salt Lake City Department of Public Utilities, November 19, 2019
- Granite Transportation Committee, November 20, 2019
- Alta, Brighton, and Snowbird Ski Resorts, December 2, 2019
- Solitude Ski Resort, December 4, 2019
- Mountainous Planning District Commission, December 5, 2019
- Sandy City staff, December 5, 2019
- Sandy City Council, December 10, 2019
- Town of Alta staff, December 10, 2019

1.3.1.4 Agency and Public Input under NEPA and SAFETEA-LU

The Little Cottonwood Canyon EIS team used several methods to involve agencies and the public during the development and screening of preliminary alternatives as required under the National Environmental Policy Act (NEPA) and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The Little Cottonwood Canyon EIS team requested agency and public input through meetings, open houses, and reviews of project materials.

SAFETEA-LU requires that the project team hold an agency scoping meeting. The initial agency scoping meeting for the Little Cottonwood Canyon EIS was held on April 9, 2018, and is described in the July 2018 *Scoping Summary Report*. Based on changes to the scope of the project, UDOT issued a revised Notice of Intent to prepare an EIS and held a second agency scoping meeting on April 3, 2019. The items that were discussed at the second meeting included the anticipated release of a new Notice of Intent identifying the need for increased capacity in Little Cottonwood Canyon; the preliminary alternatives for avalanche mitigation, improvements at trailheads, and improved mobility on Wasatch Boulevard; the purpose of and

need for the project, which remained the same as presented in previous scoping activities; and alternatives screening.

The public was also asked to review and provide comments on the proposed alternatives screening methodology and criteria and on the list of preliminary alternatives. The proposed alternatives screening methodology and criteria and the preliminary list of alternatives were posted on the project website for public review between November 4 and December 13, 2019. During this comment period, about 400 comments were received. Based on those comments, UDOT made some changes to the screening criteria.

1.3.2 Preliminary Evaluation of Concepts and Alternatives

1.3.2.1 First Preliminary Evaluation of Concepts and Alternatives

During the EIS scoping process in 2018 and 2019, UDOT received more than 1,500 comments, about 100 of which suggested concepts and alternatives for UDOT to evaluate in the EIS. As part of the preliminary evaluation of concepts and alternatives, UDOT considered these suggested concepts and alternatives to determine whether they would meet project objectives, are within the project study area, are technically feasible, and are UDOT operational improvements that are in process, or are small improvements that were considered within a larger alternative. Appendix A, Preliminary Evaluation of Alternatives and Concepts, summarizes those comments and the preliminary evaluation by UDOT. The concepts and alternatives that were not eliminated as part of the preliminary evaluation were evaluated in Level 1 screening.

The preliminary evaluation of alternatives was included in the *Draft Alternatives Development and Screening Methodology and Preliminary Concept Report*, which was provided to the public and cooperating and participating agencies for a 40-day agency and public review process. About 400 comments were received on the preliminary evaluation. None of the comments generated new alternatives or concepts that were not already being evaluated.

1.3.2.2 Second Preliminary Evaluation of Concepts and Alternatives

The preliminary concepts and alternatives that came out of the first evaluation were further defined and evaluated in this report to determine whether each concept or alternative was feasible to be considered further in Level 1 screening. The preliminary concepts and alternatives were not developed in enough detail to conduct traffic modeling or have general layouts for impact evaluation. However, each one was reviewed to determine whether the concept or alternative was technically or operationally feasible, would meet the person demand requirements to meet the project purpose, or would provide less benefit compared to other similar concepts and alternatives.

For example, there are many different types of gondola systems. The preliminary evaluation determined which gondola system would best meet the travel demand, travel time, and weather conditions necessary for Little Cottonwood Canyon. The gondola system that best met the overall requirements was carried forward for Level 1 screening.

1.3.3 Level 1 Screening Process

During the Level 1 alternatives screening phase, each of the proposed alternatives will be evaluated using criteria that identify whether the alternative reasonably meets the purpose of and need for the project.

What is the purpose of Level 1 screening?

The purpose of Level 1 screening is to eliminate alternatives that do not meet the purpose of and need for the project.

The purpose of Level 1 screening is to eliminate alternatives that do not meet the purpose of and need for the project. Alternatives that are determined by UDOT to not meet the purpose of and need for the project are considered unreasonable for NEPA purposes, not practicable under the Clean Water Act, and not prudent under Section 4(f) of the Department of Transportation Act, and were not carried forward for further analysis in Level 2 screening. (Note that some of the resources considered under these laws were not found near the alignments of some alternatives being evaluated, so those resources were not a factor in the screening process for those alternatives.) For more information, see Section 1.4, Reasons Why an Alternative Might Be Eliminated during the Screening Process.

Initial alternatives that are not eliminated during Level 1 screening will be refined and advanced to Level 2 screening. Table 1-1 lists the Level 1 screening criteria.

Table 1-1. Level 1 Screening Criteria (Purpose and Need)

Criterion	Measure
Improve mobility in 2050	• Substantially improve peak-hour per-person (defined as the 30th-busiest hour[a]) travel times in Little Cottonwood Canyon for uphill and downhill users in 2050 compared to travel times with the No-Action Alternative in 2050. • Meet peak-hour average total person-demand on busy ski days in Little Cottonwood Canyon. • Substantially reduce vehicle backups on S.R. 210 and S.R. 209 through residential areas on busy ski days (30th-busiest day). • By 2050, meet UDOT's goal of level of service (LOS) D in the weekday AM and PM peak periods on Wasatch Boulevard.
Improve reliability and safety in 2050	• Substantially reduce the number of hours and/or days during which avalanches delay users. • Substantially reduce the avalanche hazard for roadway users. • Improve roadway safety at existing trailhead locations. • Reduce or eliminate traffic conflicts between motorized and nonmotorized transportation modes at key trailhead locations. • Reduce or eliminate roadside parking to improve the safety and operational characteristics of S.R. 210.

[a] The travel demand during the 30th-busiest hour in 2050 would be about 1,555 vehicles or about 3,260 people.

1.3.4 Level 2 Screening Process

The purpose of Level 2 screening is to identify alternatives that are practicable and reasonable and should be evaluated in detail in the EIS. During Level 2 screening, UDOT collectively evaluated the alternatives that passed Level 1 screening against key criteria that focus on the alternative's impacts to the natural and built environment, estimated project costs, logistical considerations, and technological feasibility. Table 1-2 lists the Level 2 screening criteria.

What is the purpose of Level 2 screening?

The purpose of Level 2 screening is to identify alternatives that are practicable and reasonable and should be evaluated in detail in the EIS.

The overall process for Level 2 screening was:

- Estimate the impacts of each alternative that passed Level 1 screening on key resources.
- Evaluate the alternatives for costs, logistical considerations, and technological feasibility.
- Determine whether any of the alternatives would have substantially greater impacts or costs without having substantially greater benefits in meeting the purpose of and need for the project.

Using the information gathered from Level 2 screening, UDOT determined which alternatives to study in detail in the EIS.

Estimate Impacts on Resources. Using geographic information systems (GIS) software, UDOT will estimate how each alternative that passed Level 1 screening might affect resources such as wetlands and other waters of the United States, Section 4(f) and Section 6(f) resources, critical threatened and endangered species habitat, existing and planned parks and trail systems, cultural resources, camping areas, wilderness areas, and community facilities such as schools, senior centers, fire stations, and community gathering places. The amount of impacts will be determined by overlaying the estimated right-of-way for each alternative on the GIS datasets for these resources. UDOT will use the same approach to identify the potential number of impacts to homes and businesses, potential property acquisitions, and potential community impacts.

Evaluate Alternatives for Consistency with Permitting Requirements. UDOT will evaluate the alternatives independently for their consistency with applicable permitting requirements, including consideration of whether an alternative is practicable for Clean Water Act Section 404(b)(1) purposes. If an alternative is found by UDOT to be practicable and to have less adverse impacts to the aquatic environment, it will be retained for detailed analysis in the EIS. For more information, see Section 1.4, Reasons Why an Alternative Might Be Eliminated during the Screening Process.

Compare Impacts and Costs to Benefits. UDOT will use the screening results to determine whether any of the alternatives would have substantially greater impacts or costs without having substantially greater benefits to the purpose and need. Alternatives that have the same or similar benefits to other alternatives but have substantially greater impacts or costs will be eliminated and considered unreasonable for NEPA purposes.

Table 1-2. Level 2 Screening Criteria (Impacts)

Criterion	Measure
Cost	• Alternative's cost compared to other similar alternatives that pass Level 1 screening
Consistency and compatibility with local and regional plans	• Alternative's consistency with local and regional land use and transportation plans[a] • Alternative's compliance with the Wilderness Act of 1964 and consistency with the 2003 *Revised Wasatch-Cache Forest Plan*
Compatibility with permitting requirements	• Permit requirements
Impacts related to Clean Water Act	• Acres and types of wetlands and other waters of the United States[b]
Impacts to natural resources	• Acres of floodplain • Acres of critical habitat
Impacts to the built environment	• Number and area of parks • Number of community facilities • Number of potential property acquisitions including residential and business. • Number of Section 4(f)/Section 6(f) uses[c] • Number of cultural resources (for example, historic and archaeological resources) affected

[a] This criterion is a secondary objective that will be used to measure how well an alternative meets local community desires after environmental impacts are considered and to make minor shifts to alternatives' alignments. It will not be used to determine whether an alternative is reasonable or practicable.

[b] Based on Clean Water Act requirements, an alternative with a substantially greater number of wetland impacts could be eliminated from detailed study in the EIS. UDOT will not use the criteria listed in this table to eliminate alternatives from detailed study in the EIS before considering whether the alternatives would comply with the Clean Water Act Section 401(b)(1) Guidelines. Each alternative will be evaluated individually regarding cost, existing technology and logistics before the other criteria in this table are considered. For more information, see Section 1.4.2, Clean Water Act Requirements.

[c] Based on the requirements of Section 4(f) of the Department of Transportation Act of 1966 and Section 6(f) of the Land and Water Conservation Fund Act of 1965, an alternative with substantially greater Section 4(f) or Section 6(f) impacts could be eliminated from detailed study in the EIS. For more information, see Section 1.4.3, Section 4(f) and Section 6(f) Requirements.

1.4 Reasons Why an Alternative Might Be Eliminated during the Screening Process

In addition to an alternative not meeting the project purpose (Level 1 screening), other laws and guidance can also determine whether an alternative is not reasonable, as described below.

1.4.1 Council on Environmental Quality Regulations and Guidance

According to NEPA regulations and the Council on Environmental Quality, there are three primary reasons why an alternative might be determined to be not reasonable and eliminated from further consideration.

1. The alternative does not satisfy the purpose of the project (evaluated in the Level 1 screening for the S.R. 210 Project).
2. The alternative is determined to be not practical or feasible from a technical and/or economic standpoint (evaluated in the Level 2 screening for the S.R. 210 Project).
3. The alternative substantially duplicates another alternative; that is, it is otherwise reasonable but offers little or no advantage for satisfying the project's purpose, and it has impacts and/or costs that are similar to or greater than those of other, similar alternatives (evaluated in the Level 2 screening for the S.R. 210 Project).

1.4.2 Clean Water Act Requirements

Because the area of analysis for the project might support federally regulated wetlands or other waters of the United States, UDOT will also consider the Clean Water Act *Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material* (40 Code of Federal Regulations [CFR] Part 230) and Executive Order 11990, *Protection of Wetlands*, during the alternatives development phase. The U.S. Army Corps of Engineers is responsible for determining compliance with the Section 404(b)(1) Guidelines and may permit only the least environmentally damaging practicable alternative.

The Section 404(b)(1) Guidelines state that "no discharge of dredged or fill material [to Section 404–regulated waters] shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" [40 CFR Section 230.10(a)]. This section of the Guidelines further states that:

1. For the purpose of this requirement, practicable alternatives include but are not limited to:
    i. Activities which do not involve a discharge of dredged or fill material into the waters of the United States or ocean waters;
    ii. Discharges of dredged or fill material at other locations in waters of the United States or ocean waters[.]
2. An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant which could reasonably be obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered.

3. Where the activity associated with a discharge which is proposed for a special aquatic site (as defined in Subpart E [of the Guidelines]) does not require access or proximity to or siting within the special aquatic site in question to fulfill its basic purpose (i.e., is not "water dependent"), practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise. In addition, where a discharge is proposed for a special aquatic site, all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise.

To achieve compliance with the Section 404(b)(1) Guidelines, UDOT will need to demonstrate through an evaluation of alternatives in the EIS that the alternative selected in the project's Record of Decision is the least environmentally damaging practicable alternative.

1.4.3 Section 4(f) and Section 6(f) Requirements

Section 4(f) of the Department of Transportation Act of 1966 (49 USC Section 303) applies to publicly owned parks, recreation areas, and wildlife and waterfowl refuges and publicly or privately owned significant historic properties. The requirements of Section 4(f) apply only to agencies within the U.S. Department of Transportation (USDOT)—for example, FHWA. Pursuant to 23 USC Section 327 and the NEPA Assignment Memorandum of Understanding between FHWA and UDOT dated January 17, 2017, UDOT is responsible for meeting Section 4(f) and Section 6(f) requirements.

Section 4(f) prohibits USDOT agencies from approving the use of any Section 4(f) land for a transportation project, except as follows:

- First, the USDOT agency can approve the use of a Section 4(f) only if it makes a determination that (1) there is no prudent and feasible alternative that would avoid the use of the Section 4(f) property *and* (2) the project includes all possible planning to minimize harm to that property;
- Second, if there is no feasible and prudent avoidance alternative and there are multiple remaining alternatives with Section 4(f) uses, the approved alternative would cause least overall harm in light of Section 4(f)'s preservation purpose; and
- Third, the USDOT agency can approve the use of Section 4(f) property by making a finding of *de minimis* impact for that property.

What is a *de minimis* impact?

For publicly owned public parks, recreation areas, and wildlife and waterfowl refuges, a *de minimis* impact is one that would not adversely affect the activities, features, or attributes of the property.

For historic sites, a finding of *de minimis* impact means FHWA has determined that the project would have "no adverse effect" on the historic property.

Section 6(f) of the Land and Water Conservation Act requires that the conversion of lands or facilities acquired with Land and Water Conservation Act funds be approved by the U.S. Department of the Interior. Approval requires "substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location."

Section 4(f) and Section 6(f) Criteria. An alternative that would not be available because of the severity of Section 4(f) or Section 6(f) impacts could be eliminated during Level 2 screening. To achieve compliance with the Section 4(f) regulations, UDOT will need to demonstrate through an evaluation of alternatives that either (1) the alternative selected would have a *de minimis* use of Section 4(f) resources or (2) there is no

feasible and prudent alternative that would avoid the use of Section 4(f) resources, and the project includes all possible planning to minimize harm to Section 4(f) resources.

1.4.4 Wilderness Act of 1964

Little Cottonwood Canyon is in the Uinta-Wasatch-Cache National Forest. The canyon is home to two National Wilderness Areas: Twin Peaks Wilderness to the north of Little Cottonwood Canyon Road and Lone Peak Wilderness to the south. The Wilderness Act of 1964 (Public Law 88-577; 16 USC Sections 1131–1136) was established by Congress to secure for the American people of present and future generations the benefit of an enduring resource of wilderness. The Wilderness Act states that there shall be no commercial enterprise and no permanent road within any wilderness area designated by the Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of the Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.

An alternative could be eliminated because of conflicts with the Wilderness Act.

1.4.5 Appropriation of Land Owned by the United States for Highway Purposes

In Little Cottonwood Canyon, S.R. 210 crosses National Forest System (NFS)-managed land; however, UDOT does not currently have a perfected easement for the entire length of the S.R. 210 corridor on those lands. If proposed improvements would occur on NFS-managed land not already appropriated by FHWA, this action might be subject to the conditions of 23 USC Section 317, *Appropriation for Highway Purposes of Lands or Interests in Lands Owned by the United States*.

Through this appropriation process, the U.S. Secretary of Agriculture can certify that the appropriation of NFS-managed land for transportation use is contrary to the public interest or inconsistent with the purposes for which the NFS-managed land was originally reserved, or agree to the appropriation and transfer of the land to FHWA and UDOT, potentially with stipulated conditions to protect NFS-managed land. In addition, for the consideration of aerial transportation systems, UDOT will work with FHWA to determine the applicability of the use of 23 USC Section 317 for areas under such a system.

If such authorities are not applicable, UDOT might need to discuss the NEPA decision requirements of the U.S. Department of Agriculture (USDA) Forest Service, and the USDA Forest Service Special Use Permit or easement requirements, with the Forest Service to assess the authorization of such alternatives on NFS-managed land.

1.5 Consideration of Design Standards in Alternatives Development

When developing projects through the NEPA process, UDOT follows design standards for the alternatives that are developed. UDOT's standards are in place to ensure the safety of the traveling public by providing separation from roadside obstructions, providing space for vehicles to pull out of traffic in an emergency, having adequate distance to see intersections, and providing a safe place for cyclists and pedestrians. Standards are also important for roadway operations such as providing an area for storing plowed snow and conducting routine maintenance safely.

UDOT follows its design standards unless it is not reasonably possible to do so; for example, in cases where meeting one standard would cause another standard not to be met. For example, in a steep canyon, increasing the length of a road by adding more corners might reduce the roadway grade to meet grade standards, but it would not allow a sight distance standard (ability to see around corners) to be met. If the road were straightened to improve sight distance, it would reduce the length of the road and thus not meet grade standards. Additionally, UDOT might not meet clear zone standards when adding a lane if meeting the clear zone standard would cause substantial additional impacts to the natural or human environment.

What is a clear zone?

A clear zone is an unobstructed, traversable roadside area that allows a driver to stop safely or regain control of a vehicle that has left the roadway.

1.5.1 Consideration of Design Standards for Wasatch Boulevard

During the development of the project purpose and need, the design deficiencies listed in Table 1-3 on Wasatch Boulevard were mentioned by the public and verified by roadway engineers. All of the design deficiencies were addressed by using UDOT design standards for safety in developing the roadway alternatives for Wasatch Boulevard. Table 1-3 shows each design deficiency and how it was addressed by following UDOT standards.

Table 1-3. Consideration of UDOT Design Standards on Wasatch Boulevard

Design Deficiency Identified	Consideration of UDOT Design Standards
The standard shoulder width for this segment of S.R. 210 is 10 feet. The current shoulder width varies from 4 feet to 10 feet, with 4 feet being the typical width.	Alternatives were designed to meet the 10-foot design standard.
The intersection sight distance at Kings Hill Drive is insufficient.	Alternatives were designed to meet sight distance standards, which included removing some roadside obstructions and improving the curve radius at the Kings Hill Drive intersection.
The length of the deceleration lane for the center left turn at Golden Hills Avenue is substandard.	The length of the deceleration lane was increased to meet design standards.
Per UDOT's roadside design guidance, the suggested clear zone is 20 to 22 feet. There are some unprotected hazards within the clear zone including substandard barrier end treatments, trees, and steep slopes.	Alternatives were designed to meet 20- to 22-foot clear zone design standards.
95% of Wasatch Boulevard has no sidewalks or pedestrian-related facilities.	Alternatives were designed to included painted bicycle lanes in the 10-foot shoulder per UDOT design standards and include a 10-foot pedestrian trail on the east side of Wasatch Boulevard.

1.5.2 Consideration of Design Standards for S.R. 210 in Little Cottonwood Canyon

S.R. 210 in Little Cottonwood Canyon is a steep, narrow canyon road that over 6 miles climbs from an elevation of 5,400 feet at the canyon entrance to about 9,200 feet in the town of Alta. Portions of the road exceed UDOT standards for grade, sight distance (because of the winding nature of the road in the canyon), and clear zones. Table 1-4 lists the parts of S.R. 210 that do not meet design standards and how UDOT considered design standards when developing the roadway alternatives.

Table 1-4. Consideration of UDOT Design Standards on S.R. 210 in Little Cottonwood Canyon

Design Deficiency Identified	Consideration of UDOT Design Standards
The standard shoulder width for this roadway classification is 8 feet, but over 85% of this segment has shoulder widths less than 8 feet.	For alternatives that propose modifying S.R. 210 in Little Cottonwood Canyon, UDOT will meet the design standard for shoulder width (8 feet).
The stopping sight distance does not meet design guidance in several locations because trees, rocks, and steep embankments block visibility around curves. The sight distance is insufficient in the eastbound direction through the curves near mileposts 5.45, 5.60, 5.97, 6.40, and 6.67 and in the westbound direction through the curves near mileposts 10.60, 10.43, 9.50, 9.30, 8.31, 8.04, 7.95, 7.60, 6.59, 6.49, 6.30, 5.97, 5.60, 5.25, 4.80, 4.35, and 4.14.	Meeting sight distance requirements would not be reasonable throughout Little Cottonwood Canyon without extensively realigning the road. To improve sight distance around curves, UDOT would need to straighten the road, which would reduce the road length. If UDOT were to straighten the road to improve sight distance, the road grade would increase, which is already between 9% and 11% in many locations and exceeds UDOT's standard of 8%. Increasing downhill grades would reduce safety for downhill-traveling vehicles, since it would become increasingly difficult for drivers to maintain appropriate downhill speeds. Increasing uphill grades would slow vehicle traffic, thereby causing greater congestion. Overall, UDOT determined that it was not reasonable to meet UDOT's sight distance standards in Little Cottonwood Canyon because meeting sight distance standards would result in the road further exceeding grade standards.
The roadside design guidance suggests a clear zone of 14 to 16 feet. However, this segment of S.R. 210 does not meet the design guidance because it has a substantial number of unprotected hazards, with boulders, steep slopes, and trees being the majority of the hazards. The intersection sight distance is inadequate at several minor roads and parking areas at points of interest, including at the White Pine and Lisa Falls Trailheads.	Meeting clear zone design standards when making roadway improvements, such as the addition of peak-period shoulder lanes on all segments of S.R. 210, could place fill in segments of Little Cottonwood Creek, which is part of Salt Lake City's watershed. Avoiding impacts from the clear zone to the creek would require greater rock cuts into the canyon wall than what would be required for adding the peak-period shoulders only. Given the steepness of the canyon, UDOT would need to build large retaining walls with the cuts to prevent rock slides. Therefore, UDOT determined that it that was not reasonable to meet UDOT's clear zone standards on all segments of S.R. 210 in Little Cottonwood Canyon because of the additional environmental impacts the clear zones would cause in the canyon. The substandard sight distance at the Lisa Falls and White Pine Trailheads is addressed through the improved trailhead parking options considered in the EIS.
Several dedicated left-turn and right-turn lanes do not meet current standards for taper lengths and deceleration distance.	Alternatives were designed to have turn lanes that meet safety standards.

1.6 Consideration of Climate Change in Alternatives Development

Public comments provided during the EIS scoping period and the public review of the alternative screening report suggested that climate change should be considered in the development of alternatives. Specifically, public comments stated that, with the warming climate, there will be less snow and thus fewer skiers at the resorts in Little Cottonwood Canyon. The commenters stated that with fewer skiers there would not be a need to improve S.R. 210 in Little Cottonwood Canyon.

Based on the climate change literature reviewed by UDOT (see Appendix B, Little Cottonwood Canyon Alternatives and Climate Change), in 2050, the buildup of the snowpack at the canyon resorts could be delayed by 1 to 2 weeks, with little snow at Thanksgiving, and the ski season might end 1 to 2 weeks earlier. Historically, high-traffic days in the canyon have occurred from late December (typically around the Christmas holiday) through March, when the snowpack should be deep enough based on climate studies for skiing. Since most high traffic days don't occur until December and likely around the late December holiday period and end in March when snow pack should be enough to ski based on literature, climate change should not result in a need to modify alternatives that address mobility during high travel periods. In addition, sites at higher elevations (such as Snowbird and Alta ski resorts, at 7,800 feet and above) tend to be more resilient to projected changes in temperature and precipitation.

UDOT also reviewed traffic data for eastbound traffic in the canyon from the 2013 through 2018 ski seasons. These ski seasons had different yearly snow totals. During this 6-year period, there were an average of 39 travel periods per ski season with more than 1,000 vehicles in the canyon. The highest number of travel periods on S.R. 210 in Little Cottonwood Canyon with more than 1,000 vehicles (51) occurred during the 2016–2017 ski season, and the lowest number of travel periods with more than 1,000 vehicles (31) occurred during the 2014–2015 ski season. The 2014–2015 ski season had the lowest snow total of any year from the 2006–2007 ski season to the 2018–2019 ski season. Overall, the data show that, even during years with low snow totals, there are more than 30 travel periods per ski season in which the number of vehicles in the canyon exceeds 1,000 vehicles. This number (30) is only 9 below the average number for the 6-year period (39). Therefore, even with the potential for less snowfall at the resorts in the future, UDOT still expects that there would be enough heavy traffic days to justify developing alternatives that address mobility during high-travel periods.

2.0 Alternatives Development and Screening Process – Improve Mobility in 2050

Improving mobility on S.R. 210 in 2050 involves meeting two different needs: improving mobility for commuter traffic during the weekday on Wasatch Boulevard and improving mobility for the winter ski traffic on S.R. 210 along the entire corridor. The screening criteria for the weekday commuter traffic are different than for the winter ski traffic since the roadway travel demand varies by each type of traffic. Because the criteria are different, the alternatives screening process for Wasatch Boulevard in particular (see Section 2.1) was conducted separately from and prior to the alternatives screening process S.R. 210 overall (see Section 2.2). The mobility benefits provided by the Wasatch Boulevard alternatives that pass Level 1 and Level 2 screening will be considered part of the baseline conditions when evaluating how to improve mobility on S.R. 210 overall (see Section 2.2).

2.1 Improve Mobility on Wasatch Boulevard

2.1.1 Range of Alternatives

Table 2-1 lists the preliminary alternatives for improving mobility on Wasatch Boulevard that emerged from the scoping process, other public comment periods, and previous plans to be considered in the screening process for the EIS. Figure 2-1 shows the key roads and intersections discussed in this section.

To the extent practicable, when developing these alternatives, UDOT considered elements of the *Cottonwood Heights Wasatch Boulevard Master Plan Corridor Study* (City of Cottonwood Heights 2019). UDOT considered different travel modes (for example, transit, automobile, walking, and bicycling) and how they can be changed to improve transportation on the urban segment of S.R. 210 in support of the project's purpose and need.

Table 2-1. Preliminary Alternatives – Wasatch Boulevard

Alternative	Description
Mass Transit Alternative	The Mass Transit Alternative includes all current transit on Wasatch Boulevard, all future planned transit on Wasatch Boulevard in the Wasatch Front Regional Council's 2019–2050 *Wasatch Front Regional Transportation Plan*, and expanded transit proposed as part of this alternative.
Imbalanced-lane Alternative – one northbound travel lane and two southbound travel lanes (Figure 2-2)	The Imbalanced-lane Alternative includes one northbound lane from North Little Cottonwood Road to Bengal Boulevard and two southbound lanes from Bengal Boulevard to North Little Cottonwood Road. From Fort Union Boulevard to Bengal Boulevard, there would be four travel lanes, similar to existing conditions. A center two-way left-turn lane would be included from Fort Union Boulevard to North Little Cottonwood Road. At the southern end of Wasatch Boulevard, the two southbound lanes would pass through the intersection of Wasatch Boulevard and North Little Cottonwood Road and then merge down to one lane. The intersection of Kings Hill Drive with Wasatch Boulevard was evaluated both with and without a traffic signal.
Reversible Three-lane Alternative – reversible center lane (Figure 2-3)	The Reversible Three-lane Alternative would add one additional travel lane. The reversible lane would be used by northbound traffic during the morning peak period and southbound traffic during the evening peak period. During non-peak periods, the center lane would be used as a center two-way left-turn lane. The reversible lane would require lighted direction signs be placed over Wasatch Boulevard about every 1,320 feet with additional signs required at intersections and cross streets. Overall, there would be about 12 overhead signs on Wasatch Boulevard from Fort Union Boulevard to North Little Cottonwood Road. The intersection of Kings Hill Drive with Wasatch Boulevard was evaluated both with and without a traffic signal.
Five-lane Alternative (Figure 2-4)	The Five-lane Alternative would add one additional travel lane in each direction between Bengal Boulevard and North Little Cottonwood Road while maintaining a center two-way left-turn lane. At the southern end of Wasatch Boulevard, the two southbound lanes would pass through the intersection of Wasatch Boulevard and North Little Cottonwood Road and then merge down to one lane. The intersection of Kings Hill Drive with Wasatch Boulevard was evaluated both with and without a traffic signal.
Multiple Roundabouts Alternative (Figure 2-5)	The Multiple Roundabouts Alternative would add an additional travel lane in each direction, for a total of four travel lanes. It would place roundabouts at the intersections of S.R. 210 with Bengal Boulevard, 3500 East, Kings Hill Drive, and North Little Cottonwood Road. Left-turn lanes would be provided at key streets, but there would be no continuous center median.

Source: Fehr & Peers 2019

Figure 2-1. Wasatch Boulevard and Connecting Roads

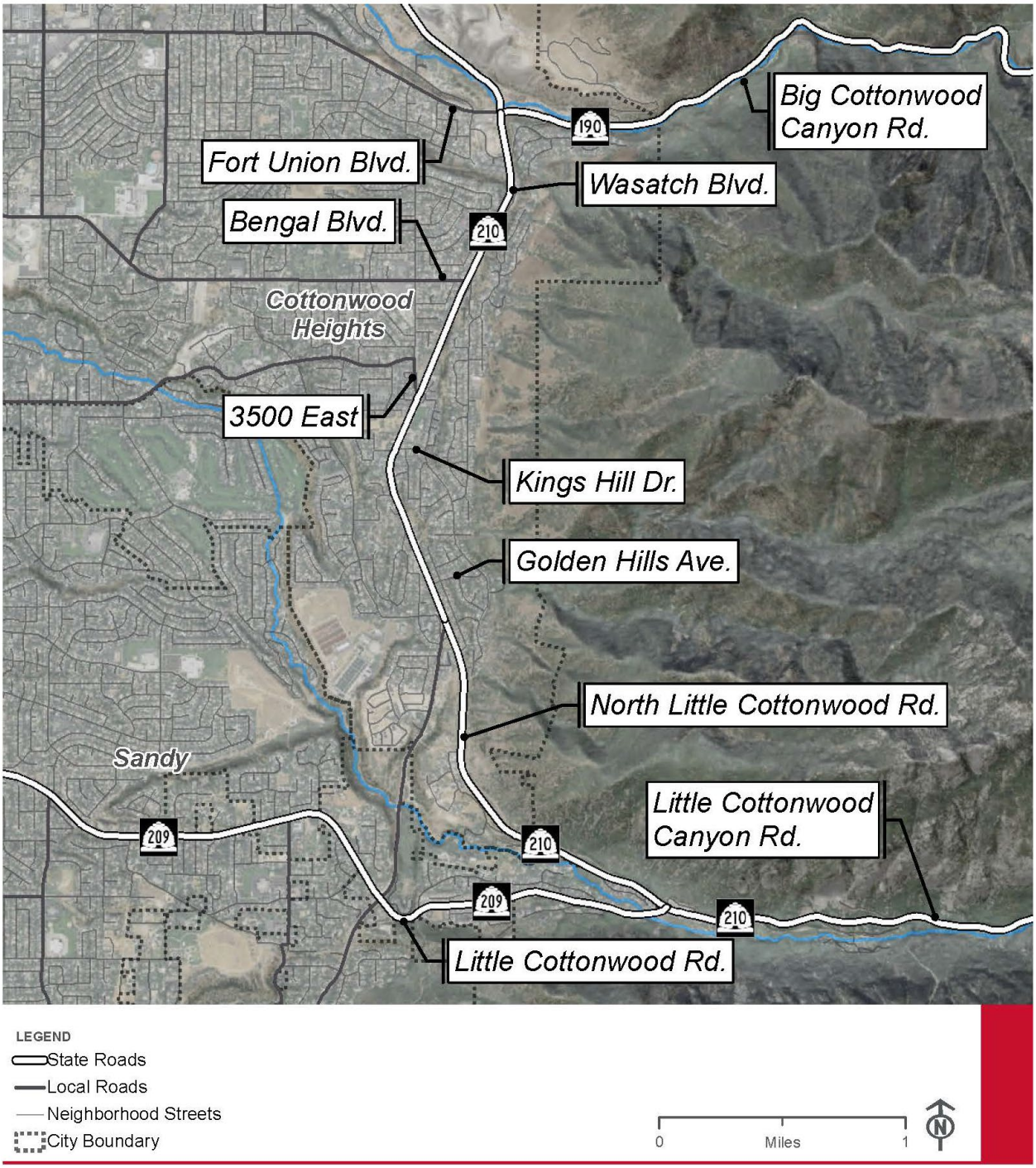


Figure 2-2. Imbalanced-lane Alternative

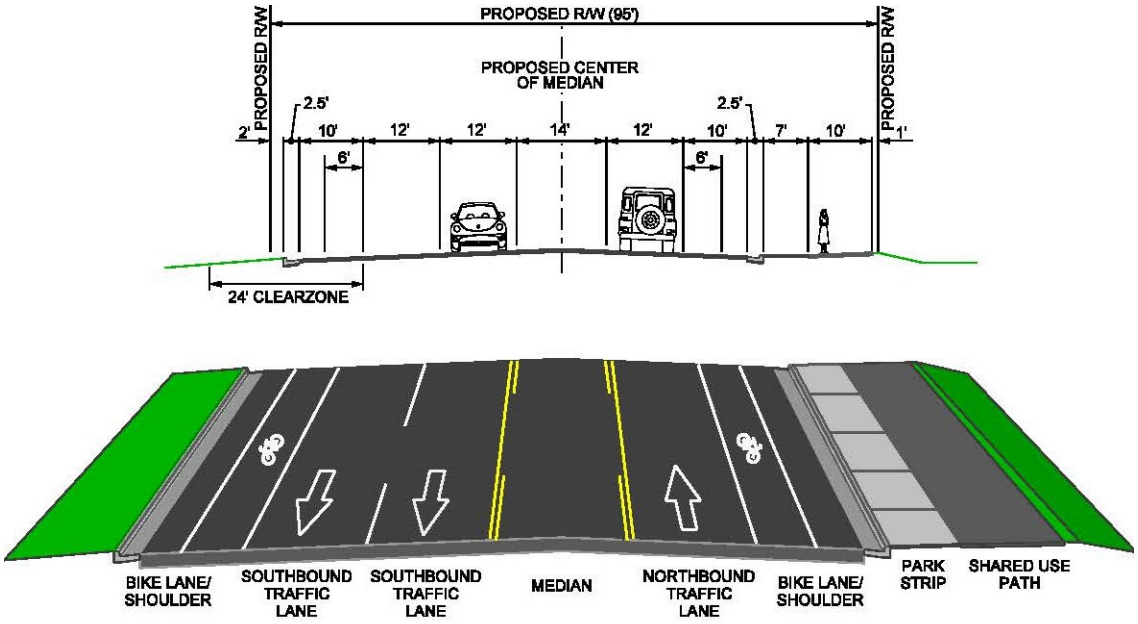


Figure 2-3. Reversible Three-lane Alternative

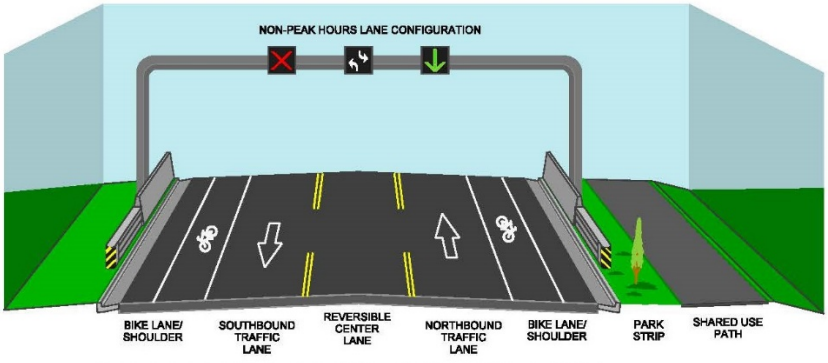


Figure 2-4. Five-lane Alternative

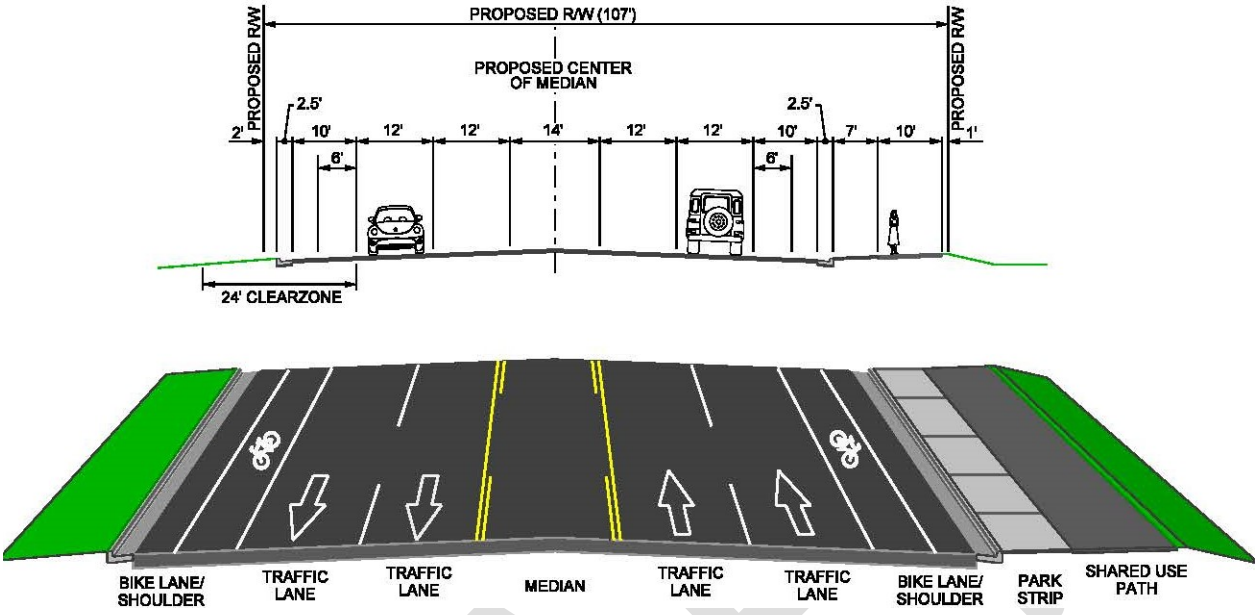
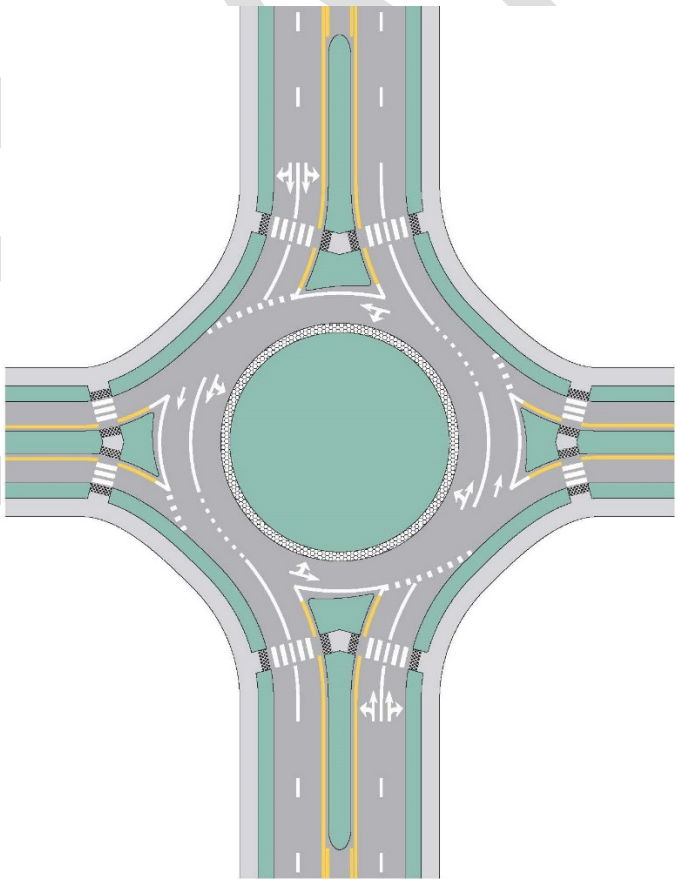


Figure 2-5. Multiple Roundabouts Alternative



2.1.2 Screening of Alternatives

As shown above in Figure 1-2, Overview of the Little Cottonwood Canyon EIS Alternatives Development and Screening Process, alternatives were screened in a three-step process consisting of a preliminary evaluation, Level 1 screening, and Level 2 screening. This section describes the three-step screening process for the five preliminary alternatives that were identified to improve mobility on Wasatch Boulevard (see Table 2-1, Preliminary Alternatives – Wasatch Boulevard, above).

2.1.2.1 Preliminary Alternatives Evaluation

The screening process included a preliminary review of each preliminary alternative in Table 2-1, Preliminary Alternatives – Wasatch Boulevard, above to determine whether it was feasible. The alternative discussed in this section was determined not to be feasible and was eliminated prior to Level 1 screening.

2.1.2.1.1 Mass Transit Alternative

During the alternatives development process, UDOT considered a mass transit alternative for commuters to alleviate weekday morning and afternoon peak traffic. Several bus routes intersect Wasatch Boulevard; however, no year-round weekday commuter bus routes run along the entire length of Wasatch Boulevard between Fort Union Boulevard and North Little Cottonwood Road. The Utah Transit Authority's (UTA) bus route 307 runs along Bengal Boulevard and along a short segment of Wasatch Boulevard near Golden Hills Park (8303 Wasatch Boulevard), while route 354 runs along Fort Union Boulevard to the intersection of Wasatch Boulevard and Fort Union Boulevard. The Cottonwood Corporate Center is the one place on Wasatch Boulevard that has a convergence of bus routes and offers a relatively high level of bus service. This area is served by routes 72 and 223, which head west and north, respectively. However, weekday ridership at these stops is still low compared to other employment centers in UTA's service area, with few stops reaching over 10 boardings per day (City of Cottonwood Heights 2019).

Even if existing bus routes were expanded to provide service farther east than what currently exists, the current low ridership on bus routes 72 and 223, coupled with low commercial densities and the predominantly single-family suburban development pattern in the project area and surrounding communities, would not easily support robust public transit.

Additionally, past transportation research has found that mass transit alternatives are efficient only in areas with a population of over 200,000 (FHWA 1987). The current population of Cottonwood Heights is less than 40,000, and the population densities in the study area's neighborhoods are low relative to the density needed for successful transit ridership. Moreover, because the traffic using Wasatch Boulevard travels to many parts of the greater Salt Lake City area, it would not be possible to provide transit service that accommodates most of the travel destinations. Because the service could not reach multiple travel destinations, it would not attract enough users to eliminate the need to improve roadway capacity on Wasatch Boulevard and intersections in 2050.

Alternative transit scenarios were modeled as part of the *Wasatch Boulevard Master Plan Corridor Study*. This study found that, in order to move people reliably through the Wasatch Boulevard corridor at acceptable levels of service, the roadway would need more vehicle capacity. The study went on to recommend adding more vehicle capacity south of Bengal Boulevard but in a way that is sensitive to and adds value to the surrounding neighborhood while prioritizing high-occupancy vehicles and future transit (City of Cottonwood Heights 2019).

The Wasatch Front Regional Council's (WFRC) 2019–2050 *Wasatch Front Regional Transportation Plan* (RTP; WFRC 2019) includes express bus service (to be implemented between 2040 and 2050) on Wasatch Boulevard running from the Little Cottonwood Canyon park-and-ride lot at the intersection of S.R. 209/S.R. 210 to I-215/3900 South, where the express bus route would connect to another express bus route heading to the University of Utah. For the analysis in this report, this express bus route on Wasatch Boulevard was considered part of the 2050 No-Action baseline conditions, which still showed congested traffic conditions on Wasatch Boulevard if no roadway capacity improvements are made.

To meet the projected traffic demand in 2050, the 2019–2050 RTP includes a combination of transit and roadway improvements on Wasatch Boulevard from Fort Union Boulevard to North Little Cottonwood Road. Because the mass transit alternative alone would not meet all of the elements of the Level 1 screening criteria, UDOT did not further consider transit-only scenarios. Since transit is included in the 2019–2050 RTP, it was assumed as part of the 2050 No-Action baseline conditions for the alternatives screening. In other words, the changes proposed as part of the roadway alternatives assume some form of transit in the future and do not preclude future transit upgrades on Wasatch Boulevard. For this reason, the overall objectives identified in the draft *Wasatch Boulevard Master Plan Corridor Study*, such as the goal to move people through the Wasatch Boulevard corridor reliably and to increase travel choices along the corridor, as well as UDOT's safety and mobility requirements, would all be addressed with any roadway alternative that is selected for this urban portion of Wasatch Boulevard.

The Mass Transit Alternative alone would not reduce congestion levels on the mainline and at the intersections of Wasatch Boulevard. For this reason, a standalone mass transit alternative for the urban section of Wasatch Boulevard was not carried forward for Level 1 screening. However, transit elements will be considered as part of all roadway alternatives evaluated in the EIS.

2.1.2.1.2 Traffic Signal at Kings Hill Drive

As part of the alternatives screening process, UDOT evaluated a traffic signal at Kings Hill Drive as part of any of the roadway action alternatives on Wasatch Boulevard. As part of the screening, UDOT conducted a traffic signal warrant study at that intersection based on the *Manual on Uniform Traffic Control Devices* (MUTCD), Chapter 4C, *Traffic Control Signal Need Studies*. The MUTCD is the law governing all traffic-control devices. It is a federal standard used by highway officials nationwide to install and maintain traffic-control devices on all streets and highways open to public travel. The MUTCD is published by FHWA under 23 CFR Part 655, Subpart F (UDOT 2011).

UDOT's review of the Kings Hill Drive intersection showed that the intersection meets the requirements for a traffic signal. However, 96% of the turning movements on Kings Hill Drive during the morning peak period are right-turning vehicles. If a dedicated right-turn lane were added on Kings Hill Drive, the signal warrant would no longer be met. There is enough room on Kings Hill Drive to stripe the road for dedicated right- and left-turn lanes without acquiring any additional right-of-way. UDOT determined that adding a traffic signal would create an off-set intersection that would not meet sight distance standards at this location, and that meeting the sight distance standards would require purchasing two homes. Therefore, UDOT decided that all of the roadway alternatives on Wasatch Boulevard would include a dedicated right- and left-turn lanes at Kings Hill Drive. Therefore, a traffic signal would not meet MUTCD warrants and was not carried forward as part of any roadway alternatives (UDOT 2018a).

2.1.2.2 Level 1 Screening

2.1.2.2.1 Level 1 Screening Alternatives

Based on UDOT's evaluation of the preliminary alternatives for improving mobility on Wasatch Boulevard, the Mass Transit Alternative and the traffic signal at Kings Hill Drive were eliminated from further consideration. The following preliminary alternatives were carried forward for Level 1 screening:

- Imbalanced-lane Alternative
- Reversible Three-lane Alternative
- Five-lane Alternative
- Multiple Roundabouts Alternative

2.1.2.2.2 Level 1 Screening Criteria

The four alternatives that were evaluated in Level 1 screening for improving mobility on Wasatch Boulevard were screened against the criterion in Table 2-2. The criterion focuses on achieving a level of service of LOS D in the morning and afternoon peak periods.

Table 2-2. Level 1 Screening Criteria – Wasatch Boulevard

Criterion	Measure
Improve mobility in 2050	• By 2050, meet UDOT's goal of LOS D in the weekday AM and PM peak periods on Wasatch Boulevard.

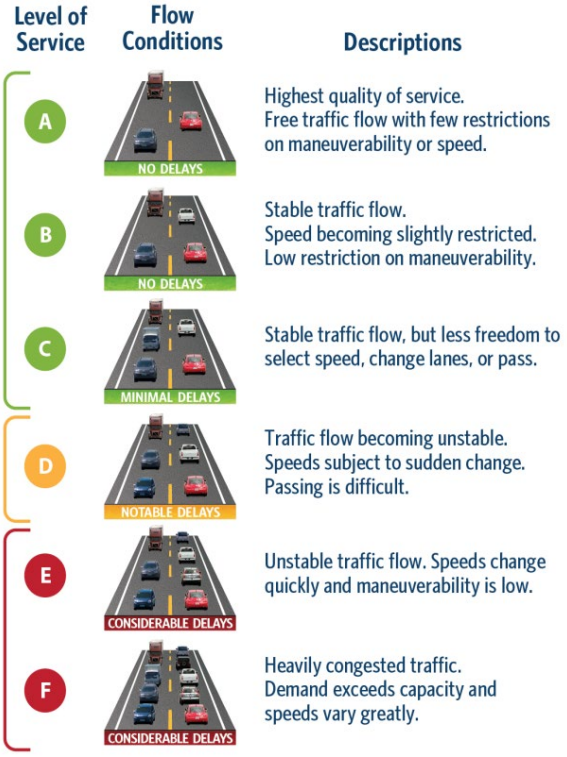
2.1.2.2.3 Level 1 Screening Methodology

Level of Service Goal. One of the goals in UDOT's 2018 *Strategic Direction* online report (UDOT 2018b) is to optimize mobility. To achieve this goal, proposed roadway projects are typically evaluated in terms of the road's modeled level of service. Level of service (LOS) is measure of the vehicle-carrying capacity and performance of a street, freeway, or intersection (Figure 2-6). When the capacity of a road is exceeded, the result is congestion, delay, and a poor level of service.

Level of service is represented by a letter "grade" ranging from A for excellent conditions (free-flowing traffic and little delay) to F for failure conditions (extremely congested, stop-and-go traffic and excessive delay). UDOT has set a goal of maintaining roads in urban parts of the state at LOS D or better during the peak travel periods. Typically, in urban areas, LOS E and F are considered unacceptable operating conditions, and LOS A through D are considered acceptable operating conditions.

UDOT chose LOS D in the peak hour as the threshold for determining whether capacity improvements are needed on Wasatch Boulevard from Fort Union Boulevard to North Little Cottonwood Road. The peak-hour estimates are based on average annual daily traffic volumes developed through traffic counts and historical growth in traffic.

Figure 2-6. Levels of Service



Travel Demand Modeling. Traffic conditions in the PM peak hour were analyzed using a VISSIM traffic analysis software. VISSIM includes functionality to account for the effects of delay at intersections and lane merge locations, which is common during peak conditions in the study area. When calibrating the VISSIM model, the Little Cottonwood Canyon EIS team used existing traffic data, signal timings, and geometric conditions data to ensure that the model reflected field observations. Because of the inherent randomness of stochastic micro-simulation tools, 10 VISSIM simulation runs were completed for each alternative to estimate the average delay.

As part of its regional planning, WFRC expects travel demand to increase as population increases. Salt Lake County is projected to have large increases in population, employment, and households by 2050 (Table 2-3). The increase in population would result in continued increased travel demand on all main roads in the transportation system and in Little Cottonwood Canyon. Utah County, to the south of Salt Lake County, is also projected to experience substantial growth in population, employment, and households, as shown in Table 2-3. This growth would likely contribute to increased travel demand on roads in Salt Lake County.

Table 2-3. Projected Regional Population, Employment, and Household Growth

Area	Population		Employment		Households	
	2017	2050 Projection (Percent Change from 2017)	2017	2050 Projection (Percent Change from 2017)	2017	2050 Projection (Percent Change from 2017)
Salt Lake County	1,127,117	1,531,282 (36%)	899,836	1,341,790 (49%)	394,665	606,036 (54%)
Utah County	623,706	1,297,515 (108%)	341,957	689,992 (102%)	177,092	419,678 (137%)

Source: Kem C. Gardner Policy Institute 2017

Based on historical traffic growth rates, UDOT applied a 1.1% linear annual growth rate for Wasatch Boulevard and a 0.5% linear annual growth rate for side streets and turning movements to develop the 2050 annual average daily traffic used in the travel demand modeling conducted for level 1 screening. This approach reflects the character of the land uses along Wasatch Boulevard, which are generally built out and have a low potential for more dense land use. Thus, the annual average daily traffic of 17,725 vehicles on Wasatch Boulevard in 2017 is expected by UDOT to grow to about 25,750 vehicles in 2050.

2.1.2.2.4 Level 1 Screening Results

Table 2-4 shows the level of service for S.R. 210 from Fort Union Boulevard to North Little Cottonwood Road for each of the Level 1 alternatives by roadway segment, and Table 2-5 shows the level of service by intersection. As shown in the tables, only the Imbalanced-lane and Five-lane Alternatives met the level of service criterion of LOS D for Wasatch Boulevard including the intersections.

The analysis also showed that some type of capacity improvement (additional travel lanes) is needed to meet the level of service criterion of LOS D. Additionally, only those two alternatives would substantially reduce travel time in both the AM and PM peak periods on the 2.2-mile segment of Wasatch Boulevard compared to the No-Action Alternative. With the No-Action Alternative, the Reversible Three-lane Alternative, and the Multiple Roundabouts Alternative, segments and intersections of Wasatch Boulevard would operate at an unacceptable level of service of LOS F.

Table 2-4. Wasatch Boulevard – Travel Demand Analysis by Direction and Segment in the PM Peak Hour in 2050

Alternative	Travel Time from Fort Union Blvd. to North Little Cottonwood Road (minutes)		Level of Service by Segment (Passing Criteria Are LOS A–D)			
	Northbound in AM/PM Peak Hour	Southbound in AM/PM Peak Hour	Fort Union Blvd. to Bengal Blvd.	Bengal Blvd. to 3500 East	3500 East to Kings Hill Drive	3500 East to North Little Cottonwood Road
No-Action Alternative	4:22 / 4:40	3:53 / 10:15	F	E	E	D
Imbalanced-lane Alternative	4:05 / 4:37	3:32 / 4:21	C	C	C	C
Reversible Three-lane Alternative	4:09 / 4:37	8:00 / 4:21	C	D	D	F
Five-lane Alternative	3:51 / 4:00	3:32 / 4:12	C	B	B	C
Multiple Roundabouts Alternative	6:25 / 4:43	4:32 / 10:21	F	D	C	C

Source: Fehr & Peers 2019
Green shading = Meets level of service goal of LOS D or better
Red shading = Does not meet level of service goal of LOS D

Table 2-5. Wasatch Boulevard – Travel Demand Analysis by Intersection in the AM and PM Peak Hours in 2050

Alternative	Level of Service by Intersection (Passing Criteria Are LOS A–D)									
	Fort Union Blvd./Wasatch Blvd.		Bengal Blvd./ Wasatch Blvd.		3500 East/ Wasatch Blvd.		Kings Hill Drive/ Wasatch Blvd.		North Little Cottonwood Road/Wasatch Blvd.	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
No-Action Alternative	B	F	C	F	B	E	B	F	D	C
Imbalanced-lane Alternative	C	D	C	C	A	B	C	D	C	D
Reversible Three-lane Alternative	C	D	C	C	D	B	D	D	F	D
Five-lane Alternative	C	C	B	B	A	B	B	C	C	D
Multiple Roundabouts Alternative	B	F	F	F	C	F	A	A	F	F

Source: Fehr & Peers 2019
Green shading = Meets level of service goal of LOS D or better
Red shading = Does not meet level of service goal of LOS D

Table 2-6 shows the results of the Level 1 screening analysis by alternative. As shown in the table, the **Imbalanced-lane Alternative** and the **Five-lane Alternative** met all of the Level 1 screening criteria and were therefore carried forward for Level 2 screening.

Table 2-6. Level 1 Screening Results – Wasatch Boulevard

Alternative	Level 1 Screening Criterion	Recommended for Further Analysis in Level 2 Screening
	Provides LOS D on Wasatch Blvd. and Intersections	
Imbalanced-lane Alternative	**Yes**	**Yes**
Reversible Three-lane Alternative	No	No
Five-lane Alternative	**Yes**	**Yes**
Multiple Roundabouts Alternative	No	No

2.1.2.3 Level 2 Screening

As a result of Level 1 screening, the Imbalanced-lane Alternative and the Five-lane Alternative were determined to meet the purpose of and need for the project and therefore were advanced into Level 2 screening.

A preliminary engineering design was developed for each of these two alternatives to determine their expected impacts according to each Level 2 criterion [Table 1-2, Level 2 Screening Criteria (Impacts), above]. Table 2-7 shows the results of Level 2 screening for the two alternatives. As shown in the table, the impacts would be similar between the Imbalanced-lane Alternative and the Five-lane Alternative.

Table 2-7. Level 2 Screening Results – Wasatch Boulevard

Impact Criterion	Unit	Alternative	
		Imbalanced-lane Alternative	Five-lane Alternative
Natural Environment[a]			
Wetlands[b]	Acres	0.65	0.65
Streams	Acres	0.03	0.03
Critical habitat	Acres	0.00	0.00
Floodplains	Acres	3.74	3.74
Impacts to wilderness areas	Acres	0.00	0.00
Built Environment[a]			
Consistency with USDA Forest Service Plan	Yes/no	Not applicable	Not applicable
Consistency with local plans	Yes/no	Yes	Yes
Recreation sites	Number	2	2
Community facilities	Number	0	0
Residential relocations	Number	1	1
Business relocations	Number	0	0
Section 4(f) properties	Number	9	9
Historic properties	Number	7	7
Cost of alternative (in 2019 dollars)	Dollars	$72 million	$76 million

[a] The acreage or number of impacts is based on a screening-level design. The actual impacts could decrease or increase based on more-detailed design conducted for the alternatives that pass Level 2 screening.

[b] The wetlands are associated with constructed stormwater-management facilities and might not be jurisdictional wetlands. The final determination of wetland jurisdiction will be made by the U.S. Army Corps of Engineers.

2.1.2.3.1 Level 2 Screening Results

The footprints and impact lines for the Imbalanced-lane Alternative and the Five-lane Alternative are similar, are mostly within the UDOT existing right-of-way, and, as shown above in Table 2-7above, would not have substantial differences in impacts to any of the listed resources. Because the two alternatives would have similar levels of impacts and costs, the Level 2 screening analysis did not give UDOT a reason to eliminate either alternative. In addition, based on the aquatic resources delineation (UDOT 2020) and UDOT's review of Section 4(f) and Section 6(f) resources, UDOT determined that the impacts to these resources would be the same for both alternatives, and these regulations did not provide a reason for eliminating either alternative. For these reasons, UDOT did not eliminate either the Imbalanced-lane Alternative or the Five-lane Alternative during Level 2 screening and advanced both alternatives for detailed evaluation in the EIS.

2.1.2.3.2 Alternatives Carried Forward for Further Evaluation in the EIS

The following Wasatch Boulevard alternatives were carried forward for further evaluation in the EIS and will be considered as part of the S.R. 210 mobility analysis described in Section 2.2:

- **Imbalanced-lane Alternative**
- **Five-lane Alternative**

2.2 Improve Mobility on S.R. 210 from Fort Union Boulevard to Alta

As stated in the introduction to Section 2.0, Alternatives Development and Screening Process – Improve Mobility in 2050, improving mobility on S.R. 210 in 2050 involves meeting two different needs: improving mobility on Wasatch Boulevard in particular for commuter traffic and improving mobility on S.R. 210 overall for winter ski traffic. This section looks at the latter need—improving mobility on S.R. 210 from Fort Union Boulevard to the town of Alta. The mobility benefits provided by the Wasatch Boulevard alternatives that passed Level 1 and Level 2 screening (see Section 2.1.2.3.2, Alternatives Carried Forward for Further Evaluation in the EIS) are considered part of the baseline conditions in this evaluation of improving mobility on S.R. 210 overall. Both the Imbalanced-lane and Five-lane Alternatives would provide a similar benefit (in terms of mobility improvement) for the S.R. 210 alternatives; therefore, the Imbalanced-lane Alternative was used for the analysis.

2.2.1 Range of Alternatives

The preliminary alternatives for improving mobility on S.R. 210 overall were developed based on previous planning studies and through the EIS agency and public scoping process. These alternatives were developed with input from existing land use and transportation plans, the public, local municipal governments, and resource agencies. The input was collected during the EIS public scoping periods (initial scoping period March 9 to May 4, 2018, and revised scoping period March 3 to June 14, 2019), at agency scoping meetings (April 9, 2018, and April 3, 2019), and in stakeholder interviews. In addition, a report describing the screening process that would be used (*Alternatives Development and Screening Methodology Report*) was placed on the project website (on November 4, 2019) and sent to cooperating and participating agencies for a 40-day public comment period (November 4 through December 13, 2019).

Table 2-8 lists the preliminary alternatives for improving mobility on S.R. 210 overall that emerged from the public involvement processes to be considered in the screening process for the EIS.

Table 2-8. Preliminary Alternatives – S.R. 210

Alternative	Description
Roadway Alternatives	
Double Stacking Alternative (Figure 2-7)	This alternative consists of closing the downhill lane on S.R. 210 in Little Cottonwood Canyon in the morning and the uphill lane in the afternoon to provide one-way vehicle flow during peak periods to reduce congestion.
S.R. 209 Roundabout Alternative (Figure 2-8)	This alternative consists of constructing a roundabout at the intersection of S.R. 209 and S.R. 210 to improve mobility in the canyon.
Reversible-lane Alternative with Moveable Barrier[a] (Figure 2-9)	This alternative consists of adding an additional travel lane on S.R. 210 (three travel lanes total) from the Wasatch Boulevard/North Little Cottonwood Road intersection to the ski resorts. This alternative would include a reversible middle lane to accommodate morning and evening peak traffic. A moveable barrier would direct traffic into the reversible lane. The reversible lane could be used at various times of day as an all-vehicle lane, a high-occupancy vehicle (HOV)/bus lane, and a bus-only lane.
Reversible-lane Alternative with Overhead Lane-control Signs (Figure 2-10)	This alternative consists of adding an additional travel lane on S.R. 210 (three travel lanes total) from the Wasatch Boulevard/North Little Cottonwood Road intersection to the ski resorts. This alternative would include a reversible middle lane to accommodate morning and evening peak traffic. Overhead signs would direct traffic into the reversible lane. The reversible lane could be used at various times of day as an all-vehicle lane, an HOV/bus lane, and a bus-only lane.
Peak-period Shoulder Lane Alternative – two lanes plus peak-hour shoulders[a] (Figure 2-11)	This alternative consists of one uphill lane and one downhill lane in Little Cottonwood Canyon with roadway shoulders large enough to accommodate vehicles. The shoulder lane could be used at various times of day by buses. The total width of pavement would be about the same as with the Reversible-lane Alternative with Moveable Barrier or the Reversible-lane Alternative with Overhead Lane-control Signs. The shoulders would be open to buses during peak travel times or when there is heavy congestion on S.R. 210. When not in use by buses, the shoulders would be open for emergency use and cyclists only. No parking would be allowed on the shoulders.
Transit Alternatives	
Bus-only Alternative – only buses allowed in Little Cottonwood Canyon	This alternative would increase bus service to meet the peak-hour person demand without increasing roadway capacity. The bus service assumes nonstop service from Fort Union Boulevard/Wasatch Boulevard and 9400 South/Highland Drive to the Snowbird and Alta ski resorts. This alternative assumes that buses would provide the primary vehicle transportation in Little Cottonwood Canyon, though nonresident and resort employee vehicles would be allowed. Similar to existing bus service, the bus routes would be on S.R. 210 and S.R. 209. For more information about the analysis of park-and-ride lot locations, see Section 2.2.2.2.5, Mobility Hub Alternatives. This alternative would operate from mobility hub locations that could include feeder bus routes to the mobility hub locations from areas across the Salt Lake Valley.
Enhanced Bus Service Alternative– buses and vehicles allowed in Little Cottonwood Canyon	This alternative would increase bus service to reduce vehicle use in the canyon. Vehicles would be allowed on S.R. 210 in Little Cottonwood Canyon, but transit would be incentivized through travel management strategies such as a toll or a prohibition on single-occupant vehicles. Two options were developed: one with 7.5-minute bus headways and the other with 5-minute bus headways. Similar to existing bus service, the bus routes would be on S.R. 210 and S.R. 209. For more information about the analysis of park-and-ride lot locations, see Section 2.2.2.2.5, Mobility Hub Alternatives. This alternative would operate from mobility hub locations that could include feeder bus routes to the mobility hub locations from areas across the Salt Lake Valley.

(*continued on next page*)

Table 2-8. Preliminary Alternatives – S.R. 210

Alternative	Description
Regional Shuttle Bus System Alternative	This alternative is similar to the existing UTA bus system but would use neighborhood parking areas dispersed throughout the Salt Lake Valley as pickup points for users. The system could operate with smaller vans or shuttles that would provide direct service from the pickup location to the resort. Given that there are two resorts in Little Cottonwood Canyon, such a system would require a substantial bus fleet to meet the needs of skiers across the valley.
Aerial Transit from the Salt Lake Valley Alternative	This alternative would provide aerial transit service from the Salt Lake Valley to the ski resorts in Little Cottonwood Canyon. It would use travel management strategies such as a toll or a prohibition on single-occupant vehicles to incentivize users to take the aerial transit system instead of personal vehicles. Several concepts were evaluated, including large cabin systems and new technologies such as SkyTran (magnetic levitation and propulsion system) and a detachable gondola cabin transported on a truck from park-and-ride lots that would connect into the cable system at the base of Little Cottonwood Canyon. There would be no bus service to the ski resorts with this alternative. The aerial transit would have enough person-capacity that additional roadway travel lanes would not be needed.
Rail Transit Alternative	This alternative would provide rail transit service from the Salt Lake Valley and use travel management strategies such as a toll or a prohibition on single-occupant vehicles incentivize users to take the rail transit system instead of personal vehicles. There would be no bus service to the ski resorts with this alternative. The rail service would have enough person-capacity that additional roadway travel lanes would not be needed. The rail alternative includes options to connect to UTA's existing light-rail system (TRAX).
Aerial Transit or Express Bus from Park City Alternative	This alternative would provide aerial transit or express bus service from Park City to the ski resorts in Little Cottonwood Canyon. This alternative assumes that vehicle traffic would be reduced enough that no additional roadway capacity would be needed.

[a] For more information about this alternative, see Appendix C, Draft Evaluation of Managed-lane Concepts.

2.2.2 Screening of Alternatives

2.2.2.1 Preliminary Alternatives Evaluation – Roadway Alternatives

The screening process included a preliminary review of each preliminary roadway alternative in Table 2-8 above to determine whether it was reasonable to be carried forward into Level 1 screening.

2.2.2.1.1 Double Stacking Alternative

This alternative would make S.R. 210 from the S.R. 209 intersection to Snowbird Ski Resort one way during the morning and afternoon peak periods on busy ski days. During the morning from 8 AM to 10 AM, the existing two lanes would both be uphill (eastbound) lanes, and in the afternoon from 3 PM to 5 PM, the existing two lanes would both be downhill (westbound) lanes. In the morning, all downhill traffic would be held at a gate on S.R. 210 near Snowbird Entry 1, and in the afternoon, all uphill traffic would be held at a gate on S.R. 210 at S.R. 209 west of the entrance to Little Cottonwood Canyon.

UDOT's review of traffic numbers showed that on a typical busy ski day (Sunday, January 13, 2019, was used for the analysis), about 2,081 vehicles went up the canyon in the morning between 8 AM and 10 AM and 2,309 vehicles went down the canyon between 3 PM and 5 PM. On that same day, 220 vehicles went down the canyon from 8 AM to 10 AM and 373 vehicles went up the canyon from 3 PM to 5 PM. It would not be prudent to prevent this many vehicles from traveling in the canyon during these timeframes. In the afternoon, many uphill vehicles are carrying late-afternoon skiers, residents, and workers needing to get into the canyon. In the morning, residents heading out of the canyon to appointments or hotel guests heading to the airport would be delayed.

In the morning, the line of backed-up vehicles on S.R. 210 waiting for the downhill lane to open would be about 0.6 mile long, and in the afternoon there would be about 1 mile of backed-up vehicles, split between S.R. 210 and S.R. 209. These vehicle backup lengths are based on an average vehicle length of 14 feet 7 inches (MechanicBase 2019). One of the project purposes is to minimize traffic backups in the neighborhoods along S.R. 210 and S.R. 209. Since this alternative would allow vehicles to back up into these neighborhoods, it would not meet the project purpose.

Finally, this alternative could reduce emergency vehicle response times. For example, currently, an emergency vehicle traveling up canyon in the morning can bypass heavy uphill congestion by periodically using the downhill lane because the lane is not congested. If both travel lanes were used for uphill traffic, this would limit other vehicles' ability to move out of the way of the emergency vehicle because of the narrow shoulders on S.R. 210. Figure 2-7 shows how double stacking could impede travel by emergency vehicles.

Because it would delay vehicle travel in the canyon, create long vehicle backup lengths, and potentially reduce emergency vehicle response times, the Double Stacking Alternative was determined to be not reasonable and was not carried forward into Level 1 screening.

Figure 2-7. Double Stacking Alternative

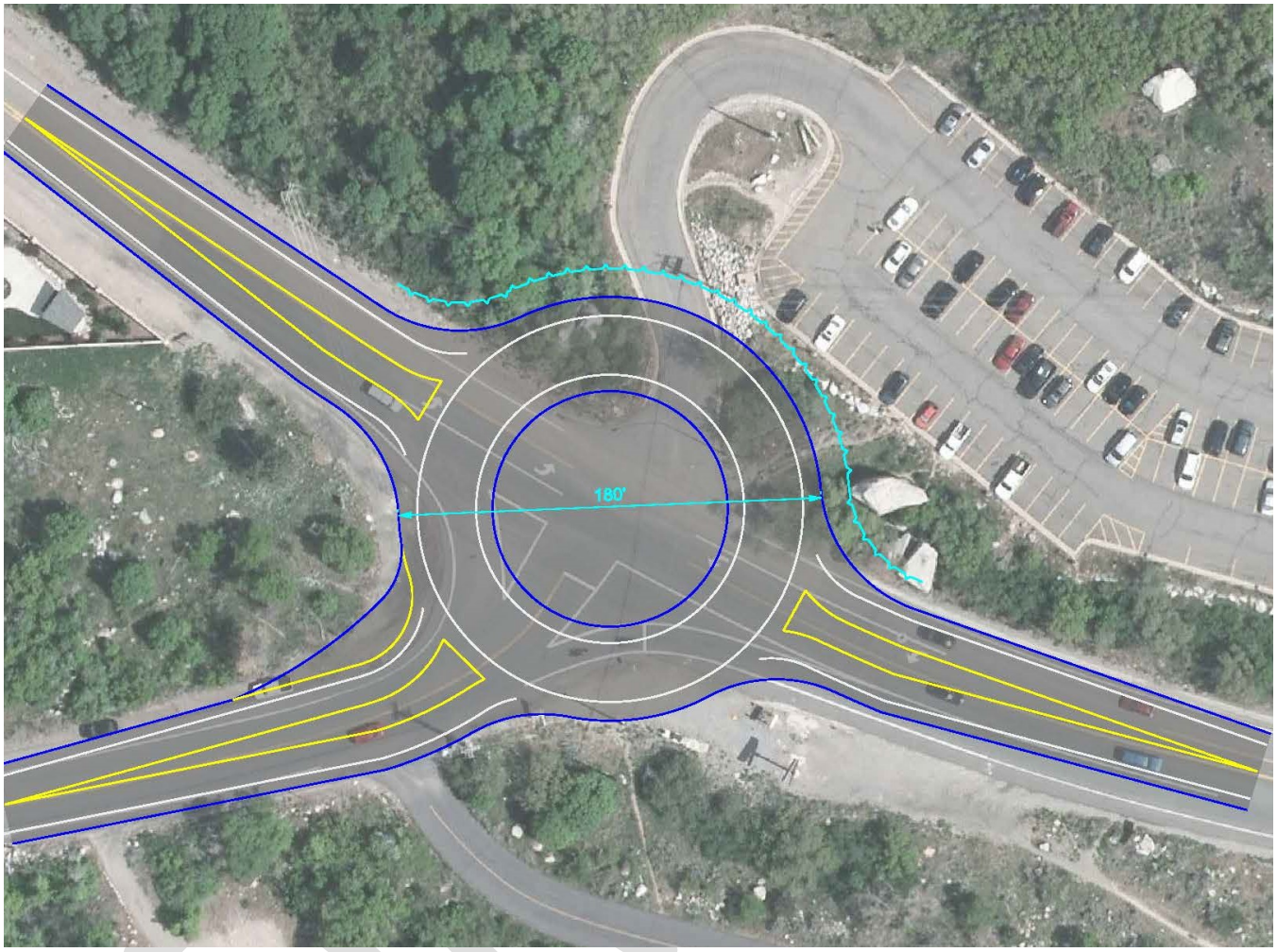
2.2.2.1.2 S.R. 209 Roundabout Alternative

This alternative would construct a roundabout at the intersection of S.R. 210 and S.R. 209 to improve the merging of traffic on these two arterial streets and thereby improve overall traffic flow. The roundabout would function similarly to the existing intersection, which has S.R. 209 merging into S.R. 210 with a merge lane. However, given the amount of traffic that heads up Little Cottonwood Canyon on S.R. 210 in the morning, it would be difficult for traffic on S.R. 209 to enter the roundabout, thereby creating vehicle backups on S.R. 209. Other potential concerns with a roundabout at this intersection based on general roundabout evaluations are as follows (NCHRP 2010):

- Vehicle slide-offs or snow that delays traffic in the canyon could routinely back up traffic into the roundabout. The successful operation of a roundabout depends on unimpeded vehicle flow on the circulatory roadway. If traffic on the circulatory roadway comes to a halt, intersection gridlock can occur.
- If S.R. 210 is operating at or near capacity, the delay could deflect all traffic entering the intersection from S.R. 209 and could introduce excessive delay.

A single-lane roundabout was designed using UDOT standards, which include accommodations for semitrailers and buses. Semitrailers frequently use S.R. 210 to deliver goods to the ski resorts. Therefore, the outer edge of the roundabout diameter would need to be about 180 feet, as shown on Figure 2-8. Overall, because of the heavy traffic during peak ski days on S.R. 210, the potential for heavy congestion at the roundabout, and the resulting vehicle backup into residential neighborhoods along S.R. 209 and S.R. 210, the S.R. 209 Roundabout Alternative was not carried forward into Level 1 screening.

Figure 2-8. S.R. 209 Roundabout Alternative



2.2.2.1.3 Managed-lane Concepts

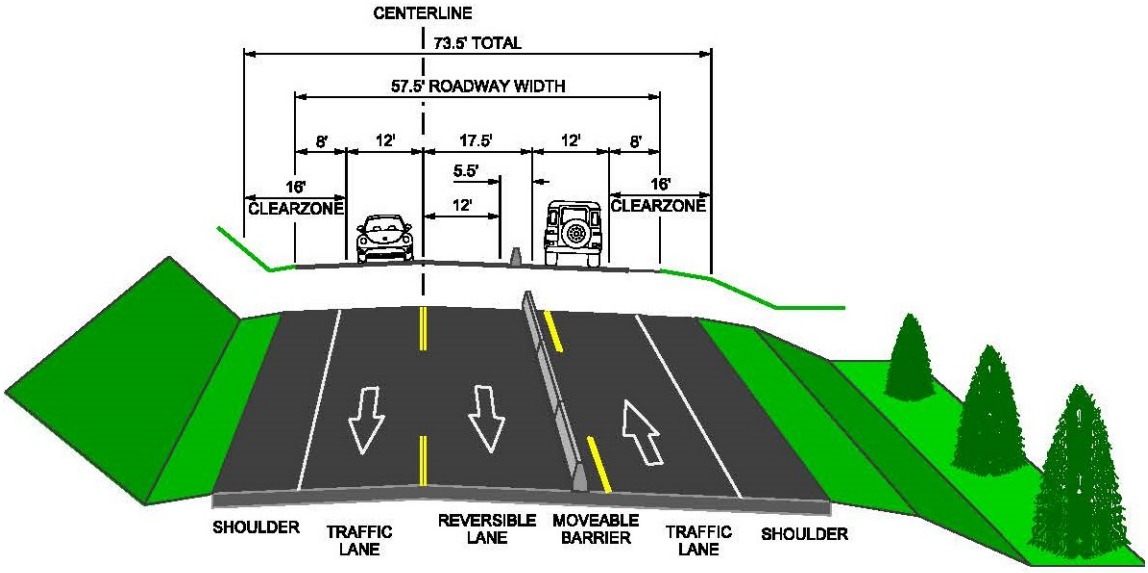
UDOT evaluated two managed-lane concepts—reversible lanes and peak-period shoulder lanes—and eliminated reversible lanes from detailed consideration in Level 1 screening. For more information, see Appendix C, Draft Evaluation of Managed-lane Concepts.

Reversible-lane Alternatives

For reversible lanes, UDOT looked at two alternatives: a moveable barrier and overhead lane-control signs.

Reversible-lane Alternative with Moveable Barrier. Reversible lanes can be implemented using moveable barrier, in which a median barrier is moved from one side of the reversible lane to the other to change the direction of traffic flow (Figure 2-9). The moveable barrier is made of short concrete segments interconnected by heavy-duty steel hinges to form a continuous wall. To move the barrier, a transfer machine lifts up each section of barrier, moves it laterally, and sets it down on the other side of the lane.

Figure 2-9. Reversible-lane Alternative with Moveable Barrier



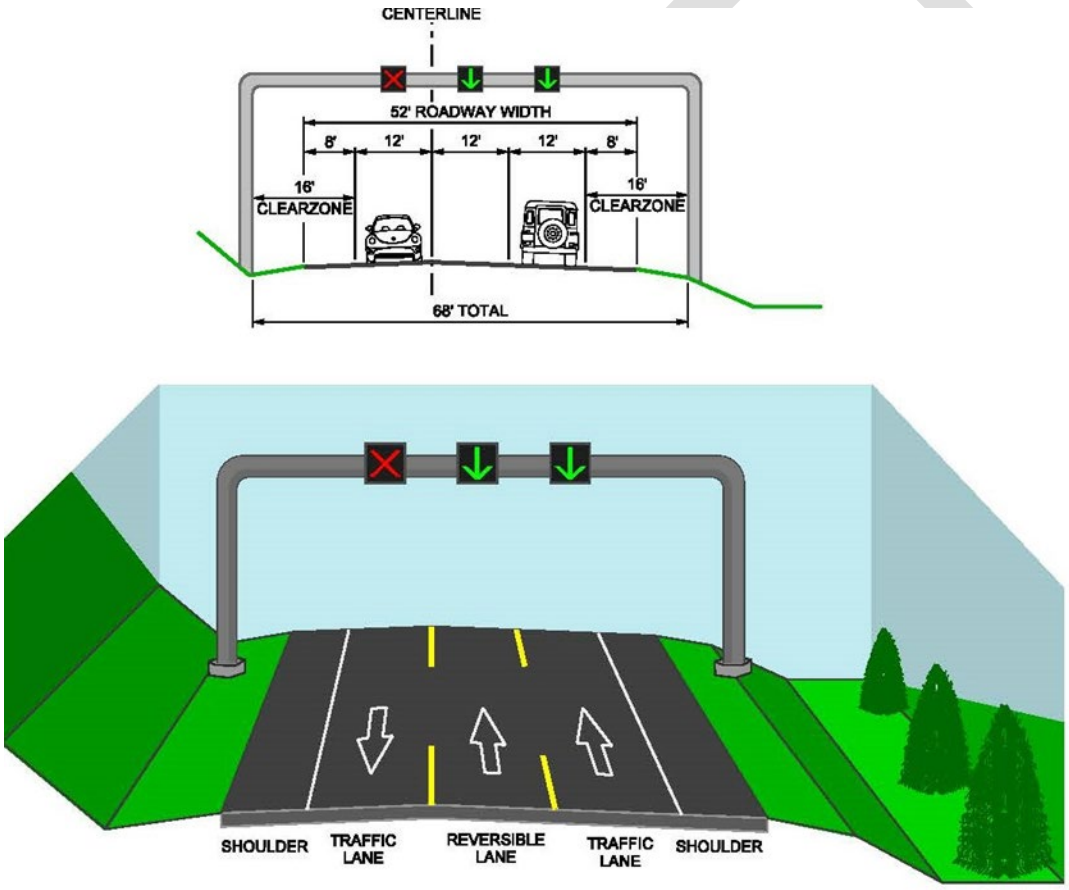
Reversible lanes with a movable barrier would require UDOT to move about 7 miles of barrier twice a day. Sometimes the barrier would need to be moved during heavy snow conditions, which would require UDOT to remove snow during the transfer process and would require a mechanism to keep the transfer machine from icing. Additionally, the barrier could be damaged if an avalanche flow hits the barrier, potentially requiring the road to be closed while the barrier is repaired.

There are other operational and safety issues as well. The barrier would limit vehicles' ability to maneuver around an accident, and a vehicle breaking down or sliding off the road could back up traffic with the barrier in place. If an accident or slide-off occurred in an area with a barrier, emergency vehicle access could also be obstructed. The barrier also has the potential to impede wildlife movement across the road. Finally, the reversible-lane transition would be complicated at intersections (S.R. 210 with S.R. 209, Snowbird Entry 1, Snowbird Entry 2, and the Bypass Road). S.R. 210 would need to be four lanes wide to accommodate

turning movements, and the lane configuration might be confusing to drivers who are not familiar with the area or with moveable barriers. For these reasons, the Reversible-lane Alternative with Moveable Barrier was not carried forward into Level 1 screening.

Reversible-lane Alternative with Overhead Lane-control Signs. The other reversible-lane alternative would use overhead signs to change the direction of the traffic flow (Figure 2-10). The lane-control signs would be placed over each lane on an overhead frame (gantry), and the text on the signs could be changeable or static. To meet safety standards, the signs would be placed such that drivers would know which lanes are allowed for use at any given time. The maximum allowable spacing is 1/3 mile (UDOT 2011), with additional signs required where sight distance is limited by sharp horizontal curves. About 41 overhead signs spaced at 1/3 mile would be necessary between the intersection with S.R. 209 and the Bypass Road. This number would increase to 62 for drivers to see two overhead signs at a time.

Figure 2-10. Reversible-lane Alternative with Overhead Lane-control Signs



For S.R. 210, lane-control signals would indicate two lanes open to eastbound (uphill) traffic and one lane open to westbound (downhill) traffic in the morning on peak traffic days. After the peak morning traffic passed, the signal for the center lane would shift to indicate two lanes open to westbound traffic and one lane open to eastbound traffic. The visual impacts of overhead signs would be in conflict with the strategies in the *Cottonwood Canyons Scenic Byways Corridor Management Plan* for protecting scenic vistas. The

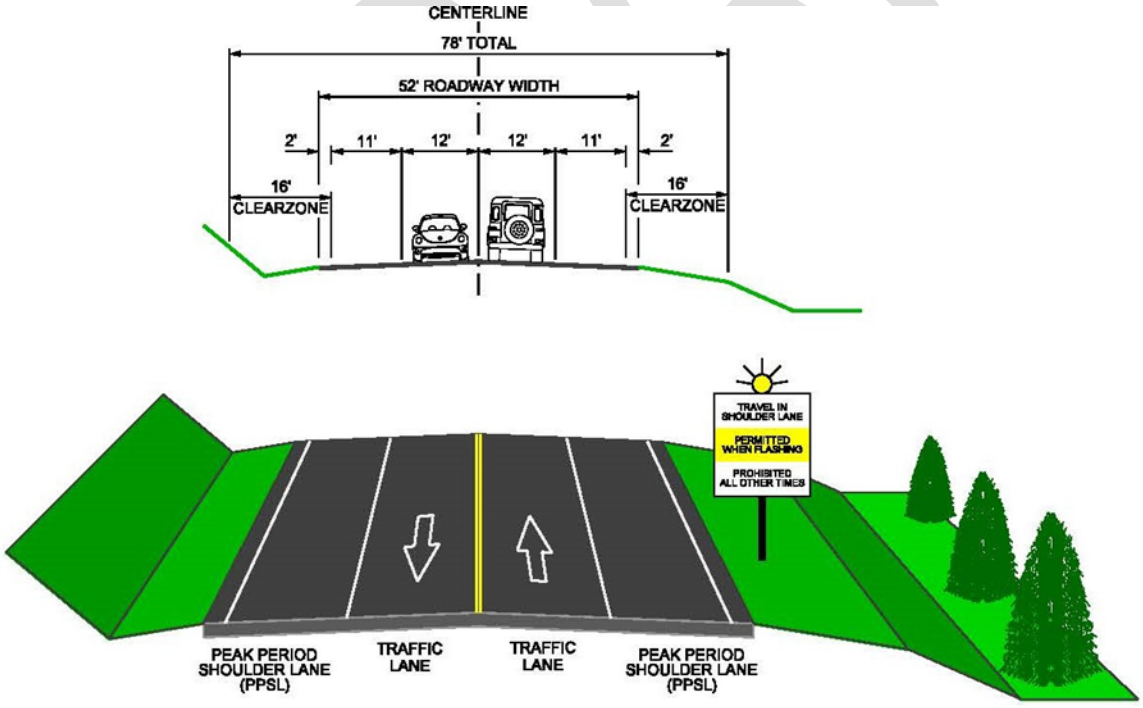
reversible-lane transition is complicated at intersections (S.R. 210 with S.R. 209, Snowbird Entry 1, Snowbird Entry 2, and the Bypass Road). S.R. 210 would need to be four lanes wide to accommodate turning movements and multiple overhead lane-control signs, and the lane configuration might be confusing to drivers who are not familiar with the area. Because of the potential visual impacts and difficult vehicle transitions on S.R. 210, the Reversible-lane Alternative with Overhead Lane-control Signs was not carried forward for further consideration.

Peak-period Shoulder Lane Alternative

In addition to reversible lanes, UDOT looked at a second managed-lane concept: peak-period shoulder lanes (PPSLs). PPSLs have been implemented in various locations across the country with a constrained right-of-way to provide additional capacity and improve mobility during peak congestion without adding another lane. With PPSLs, the roadway shoulders must be wide enough and have an appropriate pavement section to handle traffic.

A clear signing plan is needed to let drivers know when the PPSLs are open and where they can enter or exit a PPSL if access is controlled. Lane-use signals are electronic message signs located next to the PPSL indicating whether it is open or closed. The recommended spacing ranges from 1/3 to 2/3 mile (CDOT 2014). In Little Cottonwood Canyon, about 27 signs in each direction (about 54 signs total) would be required on S.R. 210 between the intersection with Wasatch Boulevard and the Bypass Road assuming 1/3 mile spacing (Figure 2-11).

Figure 2-11. Peak-period Shoulder Lane Alternative



For Little Cottonwood Canyon, the PPSLs would be in use only during peak traffic periods such as holidays and weekends during the winter. During the rest of the year, the PPSLs would be closed to vehicles and

open as bicycle lanes. The PPSLs would be open during the summer when bicycle use is the highest (although a PPSL could be in use during an emergency). No parking would be allowed in the PPSLs.

Results of Evaluation of Managed-lane Concepts

After eliminating the Reversible-lane Alternative with Overhead Lane-control Signs, UDOT compared the Peak-period Shoulder Lane Alternative and the Reversible-lane Alternative with Moveable Barrier. The PPSL alternative would be easier to operate because there would be no vehicle transition lanes as required by reversible lanes, and no equipment would be required to move a barrier. In addition, the PPSLs would not create a barrier to wildlife or impede vehicles that need to use the opposing travel lane to access an emergency.

Because the **Peak-period Shoulder Lane Alternative** would have a similar footprint as the Reversible-lane Alternative with Moveable Barrier with less visual impacts, less wildlife impacts, and easier operation, it was carried forward for detailed consideration in Level 1 screening, and the second reversible-lane alternative was eliminated. Table 2-9 compares the preliminary lane-configuration alternatives and shows that two alternatives would be similar.

Table 2-9. Impact Comparison for the Reversible-lane Alternative with Moveable Barrier and the Peak-period Shoulder Lane Alternative

Impact Category	Unit	Reversible-lane Alternative with Moveable Barrier	Peak-period Shoulder Lane Alternative
Natural Environment[a]			
Wetlands	Acres	0.00	0.00
Streams	Acres	0.33	0.34
Critical habitat	Acres	0.00	0.00
Floodplains	Acres	1.26	1.29
Impacts to wilderness areas	Acres	0.00	0.00
Built Environment[a]			
Consistency with USDA Forest Service Plan	Yes/no	Yes	Yes
Consistency with local plans	Yes/no	Not applicable	Not applicable
Recreation sites	Number	4	4
Community facilities	Number	0	0
Residential relocations	Number	0	0
Business relocations	Number	0	0
Section 4(f) properties	Number	9	9
Historic properties	Number	5	5
Cost of alternative in 2019 dollars	Dollars	$210 million	$211 million

[a] The acreage or number of impacts is based on a screening-level design. The actual impacts could decrease or increase based on more-detailed design conducted for the alternatives that pass Level 2 screening.

2.2.2.2 Preliminary Alternatives Evaluation – Transit Alternatives

In addition to evaluating roadway alternatives for improving mobility on S.R. 210 from Fort Union Boulevard to Alta, UDOT also evaluated the following types of transit alternatives:

- Bus
- Aerial transit
- Rail transit

2.2.2.2.1 Bus Alternatives

UDOT evaluated the following bus alternatives as preliminary alternatives for improving mobility on S.R. 210 from Fort Union Boulevard to Alta:

- Bus-only Alternative
- Enhanced Bus Service Alternative
- Regional Shuttle Bus System Alternative

Bus-only Alternative

The Bus-only Alternative would increase bus service to meet the peak-hour person-demand on S.R. 210 of about 3,200 persons without increasing roadway capacity. The bus-only service assumes nonstop service from the intersection of Fort Union Boulevard/Wasatch Boulevard and the intersection of 9400 South/ Highland Drive to the ski resorts with all other vehicles except employee, service, and residents' vehicles prohibited from using S.R. 210 in Little Cottonwood Canyon. For the Bus-only Alternative to meet the demand, the bus headways would need to be about 1.6 minutes from mobility hubs at both Fort Union Boulevard/Wasatch Boulevard (gravel pit area) and 9400 South/Highland Drive. This would equal about 75 buses per hour using UTA's current buses, which have a standing capacity of about 42 people.

UTA's current ski buses have special power, transmission, and automatic chain deployment systems designed to operate in a winter canyon environment. The engine and transmission requirements are necessary to handle the steep grades in Little Cottonwood Canyon (up to 11%), and the automatic chains are for the frequent snowfalls. Larger buses (articulated buses with a capacity of 80 persons) were considered but eliminated because of their poor operating conditions in a winter environment (for more information about articulated buses, see Appendix D, Draft Enhanced Bus Concepts).

UTA also stated that headways less than 5 minutes would be infeasible because it would require more than 5 minutes to load and unload a bus, particularly if riders were stowing and retrieving ski gear, and because a substantial number of buses would be needed to meet this short headway (UTA 2019). In addition, a bus-only alternative would require large parking structures of more than 5,000 parking stalls.

For these reasons, the Bus-only Alternative was not carried forward into Level 1 screening.

Enhanced Bus Service Alternative

Bus Service. Currently, UTA operates a winter ski bus service on fixed routes that makes intermediate stops before arriving at the ski resorts in Little Cottonwood Canyon. The Enhanced Bus Service Alternative would provide point-to-point bus service from mobility hubs to Snowbird and to Alta with no intermediate stops along the way (for more information about enhanced bus service, see Appendix D, Draft Enhanced Bus Concepts).

What is enhanced bus service?

Enhanced bus service is typically bus service that has intersection priority and/or travels in the roadway shoulder.

The purpose of point-to-point bus service with no intermediate stops is to improve the travel time and efficiency of the service. In addition, the loading and unloading time in the parking lot of the first resort in the canyon can add up to 15 minutes to the travel time to get to the second resort, thereby making bus service to the second resort less desirable. On occasion at the end of the day, buses sometimes fill up with passengers at the first resort and bypass the second resort, causing users at the second resort to wait for a later bus.

The Enhanced Bus Service Alternative looked at both 7.5-minute and 5-minute arrivals at the ski resorts. Less-frequent arrivals at the ski resorts would be similar to the existing service and would not provide enough bus capacity to meet the project purpose of substantially improving mobility. Arrivals of less than 5 minutes were considered infeasible because there would not be enough time for all riders to exit or board the bus and retrieve or stow their gear. The enhanced ski bus service would operate 7 days per week between 7 AM and 7 PM with peak service in the morning (7 AM to 10 AM) and afternoon (2 PM to 5 PM).

Table 2-10 summarizes the enhanced ski bus service. As shown, with Options A1 and A2 during the peak periods, 16 buses would travel in Little Cottonwood Canyon per hour, or a bus going up or down the canyon every 3 minutes 45 seconds. With Options B1 and B2 during the peak periods, 24 buses would travel in Little Cottonwood Canyon per hour, or a bus going up or down the canyon every 2 minutes 30 seconds. With Options A1 and B1, the buses would operate in mixed-flow traffic with other vehicles (the current roadway configuration). With Options A2 and B2, a peak-period shoulder bus lane would allow buses to have their own dedicated lane separate from personal vehicles.

Bus Routes. For Little Cottonwood Canyon, bus service would be provided from the existing park-and-ride lot at 9400 South and Highland Drive and from another proposed park-and-ride lot at the gravel pit located on the east side of Wasatch Boulevard between 6200 South and Fort Union Boulevard. For a summary of the results of an analysis of a proposed mobility hub, see Section 2.2.2.2.5, Mobility Hub Alternatives. The enhanced ski bus service would run between each of the proposed park-and-ride lots directly to one transit stop at either Snowbird or Alta.

Table 2-10. Details of Enhanced Bus Service Alternative and Options

Option	Description	Mobility Hub/Route	Days	Number of Buses per Hour	
				Peak/ Off-peak	Total Peak/ Off-peak
A1	Buses operating in mixed-flow traffic. (**No capacity added to S.R. 210 from North Little Cottonwood Road to Alta.**) Total capacity of 672 riders in the peak hour.	Gravel pit/ Wasatch Blvd.	Mon–Sun	8 / 4	16 / 8
		9400 South	Mon–Sun	8 / 4	
A2	Buses operating in a bus lane. (**Additional capacity added to S.R. 210 from North Little Cottonwood Road to Alta.**) Total capacity of 672 riders in the peak hour.	Gravel pit/ Wasatch Blvd.	Mon–Sun	8 / 4	16 / 8
		9400 South	Mon–Sun	8 / 4	
B1	Buses operating in mixed-flow traffic. (**No capacity added to S.R. 210 from North Little Cottonwood Road to Alta.**) Total capacity of 1,008 riders in the peak hour.	Gravel pit/ Wasatch Blvd.	Mon–Sun	12 / 6	24 / 12
		9400 South	Mon–Sun	12 / 6	
B2	Buses operating in a bus lane. (**Additional capacity added to S.R. 210 from North Little Cottonwood Road to Alta.**) Total capacity of 1,008 riders in the peak hour.	Gravel pit/ Wasatch Blvd.	Mon–Sun	12 / 6	24 / 12
		9400 South	Mon–Sun	12 / 6	

Bus Size. UTA's current ski buses have special power, transmission, and automatic chain deployment systems designed to operate in a winter canyon environment. The engine and transmission requirements are necessary to handle the steep grades in Little Cottonwood Canyon (up to 11%), and the automatic chains are for the frequent snowfalls. The current buses provide seating for 23 riders and standing room for an additional 19 riders, for a total capacity of 42 riders. For the analysis of enhanced bus service concepts, the total bus capacity of 42 riders was used. The current 35-foot buses are also more maneuverable in parking lots with limited space, such as the lots at the ski resorts. Larger buses such as articulated buses have a capacity of about 80 riders. However, studies have found that articulated buses are prone to jackknifing when operating in snow and ice on steep grades (for more information about articulated buses, see Appendix D, Draft Enhanced Bus Concepts). Even with tire chains, articulated buses might not be able to operate on steep grades in snow and ice as easily as nonarticulated buses can. Therefore, articulated buses were eliminated from further consideration.

Bus Technology. UTA's current ski buses are diesel-powered. For this alternatives analysis, the project team considered diesel buses, electric buses, and hybrid buses. Although electric bus technology is rapidly advancing, electric bus batteries currently have both limited range and performance issues on steep grades. Further, when electric heaters are used in cold weather, the heaters drain the batteries, limiting the range the bus can travel before needing to charge. Currently, most transit authorities heat any electric buses in their fleet using a diesel fuel heating system. Because electric bus technology is still evolving, electric buses were eliminated from consideration. This evaluation of enhanced ski bus service assumes the use of diesel buses with a total capacity of 42 riders, the same as UTA's current ski buses. If electric bus technology improves in the future, the enhanced ski bus service could use this technology. Hybrid buses could be considered as a bus option if they can be designed to meet the requirements of the steep mountain grades, maneuverability at the resorts, and chains.

Regional Shuttle Bus System Alternative

The Regional Shuttle Bus System Alternative is similar to UTA's existing bus system with park-and-ride lots, but it would use smaller parking areas dispersed throughout the Salt Lake Valley as pickup points for riders. A rider would arrive at a lot near their home at a designated time to catch a shuttle to their specific resort. Buses would likely be smaller shuttles, since the demand at each pickup location would be less than at a typical UTA park-and-ride lot. Given that there are two resorts in Little Cottonwood Canyon, such a system would require a substantial bus fleet to meet the needs of skiers across the valley.

One comment that UDOT received suggested regional transit (bus or rail) to feed a mobility hub at the base of Big Cottonwood Canyon. The commenter suggested that buses or rail from Salt Lake City could connect to the mobility hub, thereby reducing the need for recreationists to drive their vehicles to the mobility hub. The commenter suggested bus or rail down Foothill Drive and Wasatch Boulevard or rail connecting to the existing light-rail system.

What is a mobility hub?

A mobility hub is a location where users can transfer from their personal vehicle to a bus.

UDOT is evaluating a mobility hub (or hubs) concept for the S.R. 210 transit alternatives that would allow bus routes or other forms of transit to be located near the bases of the Cottonwood Canyons. Transit service from a mobility hub near Little Cottonwood Canyon to the ski resorts would reduce the distance of travel compared to a regional bus route starting near Salt Lake City, for example. Such transit service would therefore reduce the travel time, which would result in a more reliable service. The mobility hub would also reduce the capital and operating costs of bus service because fewer buses would be needed because the mobility hub would be located closer to Little Cottonwood Canyon which would result in shorter bus travel times. The mobility hub(s) concept is an important part of any transit alternative because it provides greater reliability in service and enough parking to accommodate the high number of potential users. Therefore, the EIS will evaluate the mobility hub(s) concept.

A regional shuttle bus system or feeder service to the mobility hub(s) from locations outside the EIS study area, such as downtown Salt Lake City, can be addressed without an EIS process by UTA adding or changing its current service routes. Also, private vendors could also develop feeder services to the mobility hub(s) locations. Without the mobility hub(s), the regional shuttle bus service would not function. For analysis in the EIS, a regional shuttle bus system was assumed to provide the same service levels as the Enhanced Bus Service Alternative, so it is not evaluated in the EIS as a separate alternative.

If an alternative with a mobility hub is selected in the EIS, UDOT would phase construction by starting with a smaller parking garage and expanding it as warranted based on demand. This phased expansion would allow UTA and private vendors to evaluate how the mobility hub(s) concept is functioning to determine the viability and type of feeder service. Considering feeder services prior to the operation of the mobility hub(s) would be speculative because it would be difficult for UTA to determine the demand and best location for feeder service without understanding the actual demand and function of the mobility hub(s) concept first.

Instead of a regional bus system, UDOT considered a rail alternative with a connection to UTA's TRAX light-rail system as part of the rail alternative. Connecting to the existing light-rail system would provide a transit connection throughout the Salt Lake Valley. The alternative being evaluated (see Section 2.2.2.2.3, Rail Transit Alternative) would connect to UTA's existing light-rail line at the Sandy Expo TRAX Station or the Midvale Fort Union TRAX Station and proceed to the ski resorts in Little Cottonwood Canyon. Some commenters suggested running the light rail down Foothill Drive and Wasatch Boulevard. UDOT selected

connecting to the Sandy Expo or Midvale Fort Union stations because they would have shorter travel distances than the Foothill Drive/Wasatch Boulevard option (at least 5 miles shorter), achieve the same goal for connecting Salt Lake City light rail to the ski resorts, and have the shortest distance of new rail and thus would cost less and have fewer impacts.

Bus Alternative Selected for Level 1 Screening

Based on the above analysis, UDOT carried the **Enhanced Bus Service Alternative** forward for Level 1 screening and eliminated the Bus-only Alternative and the Regional Shuttle Bus System Alternative. UDOT selected the Enhanced Bus Service Alternative because it would provide frequent and convenient service and could be implemented. As stated in Section 2.2.2.2.1, Bus Alternatives, for the Bus-only Alternative to meet the person-demand, it would need to operate at headways of less than 5 minutes. UTA considers such short headways infeasible because riders could not board and exit the bus (and stow and retrieve their ski gear) within 5 minutes. The Regional Bus Shuttle System Alternative is not evaluated further because, once the mobility hub concept is implemented, a regional bus shuttle system could be implemented independent of the S.R. 210 Project.

2.2.2.2.2 Aerial Transit from the Salt Lake Valley Alternative

Aerial Transit Systems Evaluated

UDOT initially evaluated four types of aerial transit systems as preliminary alternatives for improving mobility on S.R. 210 from Fort Union Boulevard to Alta: aerial tramways, funifors, funitels, and gondolas. As discussed in Appendix E, Draft Aerial Transit Initial Feasibility Study, of the four systems, UDOT selected gondolas as the best alternative for Little Cottonwood Canyon because of their faster travel time and higher person-capacity.

UDOT evaluated three types of gondola systems: mono-cable (1S), bi-cable (2S), and tri-cable (3S). Table 2-11 compares these gondola systems.

Why are gondola types abbreviated 1S, 2S, and 3S?

These abbreviations come from the German word *Seil*, which means “cable,” and refer to the number of cables used to propel and support the gondola cabins.

Table 2-11. Comparison of Gondola Systems

Parameter	Mono-cable (1S)[a]	Bi-cable (2S)	Tri-cable (3S)[a]
Capacity per cabin (number of people, maximum)	8 to 15	8 to 17	20 to 35
Travel speed (mph)	9 to 11	15 to 16	16 to 18
Operational wind speeds (mph)	37	43	68
Maximum capacity (approximate number of people per hour per direction)[b]	3,000	4,000	5,000
Approximate maximum tower spacing (feet)	2,300	3,000	9,000
Travel Times[c]			
Entrance of canyon to Snowbird (minutes to travel 6.5 miles)	35	26	23
Snowbird to Alta (minutes to travel 1.5 miles)	8	6	4
Total (minutes to travel 8 miles)	**44**	**32**	**27**

[a] Source: Fehr & Peers 2012

[b] The maximum hourly capacities are based on literature reviews and do not necessarily represent the gondola capacity in the Little Cottonwood Canyon setting.

[c] Travel times are calculated based on travel speeds (1S: 11 mph; 2S: 15 mph; 3S: 17 mph) and the distance between the base and terminal station.

The 1S system was eliminated from consideration because it had the lowest per-cabin capacity, had the slowest travel speeds and times, and would require the most towers. Both the 2S and 3S systems would provide reliable and safe transportation. However, the 3S provides some specific advantages including greater person-capacity, faster speeds, and greater potential tower spacing. The greater tower spacing provides more opportunity to avoid sensitive environmental areas and span avalanche paths.

Although the smaller 2S towers could have less visual impacts, UDOT would likely need to build more towers. Additionally, one disadvantage of the 2S system is that it does not have “slack carriers.” Slack carriers in the 3S system are pieces of equipment that are connected to the two support cables and that support the haul cable at all times. In a 2S system, the cabins themselves support the haul cable between the towers. Whenever the cabins are removed from the haul cable (for maintenance), the haul cable sags low. Therefore, a 2S system requires shorter distances between towers to keep the haul cable from touching the ground when the cabins are removed, and this could increase the number of towers required compared to a 3S system. Because it would have the greatest maximum capacity, fastest travel times, and greatest operational benefits (most stability in high winds), the 3S-type gondola is the most feasible gondola system for Little Cottonwood Canyon.

Gondola Alternatives Evaluated

Once UDOT selected the 3S-type gondola, UDOT then evaluated four alignments for the gondola from the Salt Lake Valley to Snowbird and Alta ski resorts (for more information about each alternative, see Appendix E, Draft Aerial Transit Initial Feasibility Study):

- **Gondola Alternative 1** – Expanded parking and base station at the entrance of the canyon
- **Gondola Alternative 2** – Expanded parking and base station 1 mile from the entrance of the canyon
- **Gondola Alternative 3** – Expanded parking at a mobility hub at the gravel pit (near Wasatch Boulevard and Fort Union Boulevard)
    - **Gondola Alternative 3, Option A** – A complete gondola alignment from the gravel pit mobility hub to the entrance of the canyon and continuing to the resorts
    - **Gondola Alternative 3, Option B** – A bus trip from the gravel pit mobility hub to a base station at the entrance of the canyon
- **Gondola Alternative 4** – Expanded parking at a mobility hub near 9400 South (S.R. 209) and Highland Drive
    - **Gondola Alternative 4, Option A** – A complete gondola alignment from the 9400 South/Highland Drive mobility hub to the entrance of the canyon and continuing to the resorts
    - **Gondola Alternative 4, Option B** – A bus trip from the 9400 South/Highland Drive mobility hub to a base station at the entrance of the canyon

Figure 2-12 shows the gondola alternatives that were considered.

Figure 2-12. Gondola Alternatives Evaluated

Gondola Alternatives Comparison

In addition to comparing the preliminary gondola alternatives in terms of their travel time, capital cost, and operation and maintenance (O&M) cost, UDOT also compared the alternatives in terms of feasibility criteria pertaining to the purpose of the S.R. 210 Project (improved mobility and improved neighborhood access). UDOT also included feasibility criteria pertaining to residential impacts and privacy issues, which are considerations that apply to gondolas in an urban environment. Other environmental impacts would be addressed in the EIS if a gondola alternatives is selected for detailed analysis. These additional feasibility criteria are described below, and the alternatives' ratings for these criteria are summarized in Table 2-12.

Impacts on Congestion. Improving mobility is an element of the S.R. 210 Project's purpose because traffic backs up at the intersection of S.R. 210 and S.R. 209 and clogs residential neighborhoods. In Table 2-12, impacts on traffic congestion represents the effect on the surrounding area. For example, Gondola Alternatives 1 and 2 would not change the existing travel patterns and would result in high volumes of traffic at the entrance of Little Cottonwood Canyon, so they are rated as having a high impact for this comparison criterion. In contrast, Gondola Alternative 3 would keep traffic near the existing interstate (I-215), near higher-capacity existing roads, and next to existing commercial areas, and is therefore rated as having a low impact in terms of causing traffic congestion.

Needed Roadway Improvements. This criterion qualitatively captures the degree of roadway improvements needed to provide priority travel for buses and needed infrastructure improvements near the mobility hub for efficient access to parking. Gondola Alternatives 3A and 3B are rated as having a low impact for this criterion because existing infrastructure near the gravel pit mobility hub can accommodate the expected traffic, and planned improvements to Wasatch Boulevard will help bus travel. Gondola Alternatives 1 and 2 are rated as having medium impacts because some roadway improvements would be needed near the parking garage in this more-residential area. Gondola Alternative 4B would require significant improvements from 9400 South and Highland Drive to the entrance of Little Cottonwood Canyon in order to maximize bus travel times. Therefore, Gondola Alternative 4B is rated as having a high impact for this criterion.

Residential Impacts. UDOT assumes that owners of residences directly under the gondola's airspace would need to be relocated. A low impact is assigned for this criterion for alternatives that have gondola alignments in the rural segments only (Gondola Alternatives 1, 3B, and 4B). A high impact is assigned for alternatives that have gondola alignments in the urban segments (Gondola Alternatives 3A and 4A).

Privacy Concerns. This criterion looks at the general number of homes that would be adjacent to the gondola alignment within view of gondola riders in the gondola cabin. Because the cabins would be elevated 100 to 200 feet in the air, privacy would be a concern for residents beyond the areas immediately adjacent to the gondola alignment. There is a large amount of residential development along Wasatch Boulevard and 9400 South. Like the residential impacts criterion, a low impact is assigned for this criterion for alternatives that have gondola alignments in the canyon segment only (Gondola Alternatives 1, 3B, and 4B), and a high impact is assigned for alternatives that have gondola alignments in the urban segments Gondola Alternatives 3A and 4A). For the alternatives in which the base station is located away from the entrance of Little Cottonwood Canyon, UDOT expects the public to strongly oppose these alternatives due to these privacy concerns.

When comparing these rankings, Gondola Alternative 3B has the lowest impact across the four additional feasibility criteria presented in this section. Gondola Alternative 3A is better than Gondola Alternative 1 from

traffic congestion and needed roadway improvements standpoint, but implementation would be challenging because of high residential impacts and privacy concerns.

Table 2-12 summarizes all of the comparison criteria for the gondola alternatives presented in this report.

Table 2-12. Comparison of Gondola Costs, Travel Time, and Additional Feasibility Criteria

Gondola Alternative	Costs		Travel Time	Additional Feasibility Criteria[a]			
	Capital Cost (million $)	Annual O&M Cost (million $)	Total Travel Time to Alta (minutes)	Impacts on Traffic Congestion	Needed Roadway Improve-ments	Residential Impacts	Privacy Concerns
1	262.6 – 288.8	3.1 – 3.5	54	High	Medium	Low	Low
2	299.8 – 329.7	3.1 – 3.5	58	High	Medium	Medium	Medium
3A	375.6 – 413.2	4.3 – 4.8	68	Low	Low	High	High
3B[b]	312.2 – 343.4	4.1 – 4.5	62	Low	Low	Low	Low
4A	398.4 – 438.2	4.3 – 4.8	70[c]	Medium	Low	High	High
4B[b]	312.2 – 343.4	4.1 – 3.5	60[c]	Medium	High	Low	Low

[a] High impact means that the impact is greater, such as heavier congestion, greater need for roadway improvements, higher residential impacts, and greater privacy concerns. Low impact means less congestion, fewer needed roadway improvements, less residential impacts, and fewer privacy concerns.

[b] Annual O&M cost for Gondola Alternatives 3B and 4B would be about $3.8 million to $4.2 million with a modified bus schedule that has a lower hour capacity during off-peak weekend hours and weekdays.

[c] Travel time does not include a personal vehicle trip in the segment from Wasatch Boulevard and Fort Union Boulevard to a mobility hub at 9400 South and Highland Drive.

Gondola Alternative Selected for Level 1 Screening

Based on the above analysis, UDOT decided to carry **Gondola Alternative 3B** forward for Level 1 screening and to eliminate Gondola Alternatives 1, 2, 3A, 4A, and 4B. UDOT selected Gondola Alternative 3B because it would have the second-lowest overall capital cost, the fewest impacts to traffic and residential properties, and less privacy concerns. Although Gondola Alternative 4B would have a similar travel time, cost, and impacts as Gondola Alternative 3B, the parking area would be located about 3.5 miles from I-15 and about 6 miles from I-215 and would require canyon users to travel on Wasatch Boulevard or 9400 South. This route could create more traffic congestion, whereas a parking area at the gravel pit would be about 1 mile from I-215, which would result in a faster travel time because about 60% of traffic in Little Cottonwood Canyon uses I-215 and S.R. 210 to access the canyon. Gondola Alternative 4B would also need more roadway improvements to prioritize buses.

Gondola Alternative 1 would have the lowest capital cost, the lowest operational cost, and the fastest travel time; however, one of the purposes of improving mobility on S.R. 210 is to reduce traffic impacts to residential areas along S.R. 210 and S.R. 209 at the entrance to Little Cottonwood Canyon. Gondola Alternatives 1 and 2 would focus traffic on S.R. 210 and S.R. 209. These alternatives were eliminated from further study because the traffic congestion with these alternatives would be similar to existing traffic conditions, which focus peak-hour traffic to the entrance of Little Cottonwood Canyon in residential areas and restrict residents' ability to access their homes during peak ski periods. In addition, both Gondola Alternatives 1 and 2 would include building a 2,500-car multistory parking structure in a residential area, and a parking structure which would not be compatible with existing residential land uses. Gondola Alternative 2 would further cause privacy concerns since the gondola corridor would be near existing homes along S.R. 210 near the entrance to the canyon. For these reasons, Gondola Alternatives 1 and 2 were not carried forward for Level 1 screening.

Gondola Alternatives 3A and 4A had the highest capital cost, high impacts to residential properties, and most privacy concerns, and therefore were not carried forward for Level 1 screening.

In recommending Gondola Alternative 3B, UDOT realizes that scenarios with bus service that match the gondola capacity (of about 1,000 people per hour) have the higher annual operating cost and 8 minutes' more travel time than the best-performing gondola alternative (Gondola Alternative 1). UDOT determined that the traffic impacts of locating a parking garage near the entrance to Little Cottonwood Canyon with traffic congestion similar to the existing traffic conditions outweighed the additional O&M cost and travel time. In addition, bus service can be optimized to better match off-peak demands and actual ridership. The actual operating costs for Gondola Alternative 3B could be slightly lower ($3.8 million to $4.2 million) than what has been estimated in Table 2-12 above ($4.3 million to $4.8 million) with a modified bus schedule during off-peak times.

2.2.2.2.3 Rail Transit Alternative

Rail Transit Systems Evaluated

UDOT initially evaluated the following seven types of rail transit system as preliminary alternatives for improving mobility on S.R. 210 from Fort Union Boulevard to Alta:

1. Heavy/commuter rail
2. Light rail
3. Cog rail
4. Monorail
5. Maglev
6. SkyTran
7. Funiculars

Heavy/commuter rail, light rail, monorail, and maglev were eliminated from further consideration because they cannot operate on such steep grades.

SkyTran, which was suggested by a commenter, was eliminated because no technical information was provided to UDOT regarding the levitation or propulsion system or regarding the control technology needed to meter vehicles into the main-track traffic, and no test facility has been constructed. UDOT considers the technology theoretical and therefore not feasible for Little Cottonwood Canyon.

Funiculars were eliminated because the technology is not feasible to handle the high hourly rider demands in Little Cottonwood Canyon.

Finally, a commenter provided a new concept to UDOT called the Dual-mode Advanced Vehicular Endeavor, or D.A.V.E. This system uses an ordinary automobile (or light truck) adapted with a mounting device so that it can drive on the street network and then be picked up by a fixed guideway and travel above ground. Based on an internet search and a review of transportation and transit resources, UDOT did not find any examples where a D.A.V.E. concept has been implemented. The idea of dual-mode vehicles (that can operate on either roads or fixed guideways) has been previously discussed among various transit agencies, but UDOT could not find any examples where either dual-mode transit vehicles or dual-mode personal automobiles have been installed operationally. UDOT determined that the D.A.V.E concept would require a technology that does not currently exist and is not commercially or institutionally available.

Additionally, the D.A.V.E. concept would require users to either purchase new vehicles that could be used on the D.A.V.E. guideway system or purchase equipment that would allow their personal vehicles to be used with the D.A.V.E. guideway system. Neither the new vehicles nor the modification equipment are commercially available. Even if it were available, the State of Utah could not require drivers to purchase the vehicles or equipment to use the D.A.V.E. system. Because a commercially available product is not available, designing a D.A.V.E. alternative for the S.R. 210 Project would require an extensive and costly research and development process. For these reasons, the D.A.V.E. concept does not meet the logistical, technological, or economic requirements for a reasonable or practicable Little Cottonwood Canyon alternative.

As discussed in Appendix F, Draft Rail Transit Concepts Initial Feasibility Study, of the seven types of rail systems, UDOT selected **cog rail** as the best system for Little Cottonwood Canyon because it can operate on the steep grades in the canyon (up to 11%) and can be used with UTA's existing light-rail network.

Cog Rail Alternatives Evaluated

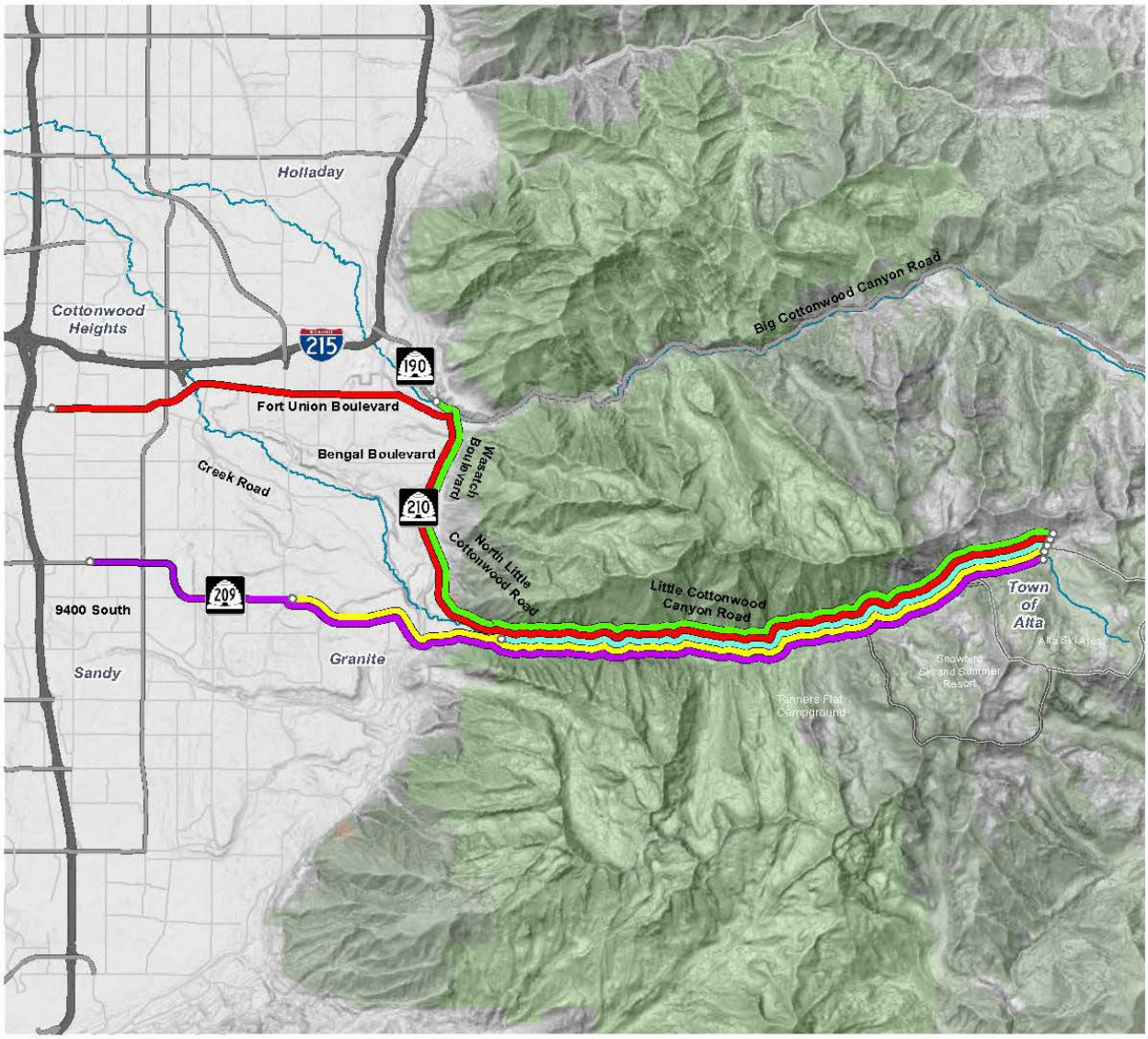
Cog rail, also called rack rail or mountain rail, is a type of light rail. Cog rail uses a third rail that is toothed or racked. Train vehicles are fitted with a cog wheel (also called a pinion wheel) that meshes with the third rail to provide additional traction. This additional traction is needed primarily for downhill travel where the added stopping power of the cog wheel is needed in addition to the adhesion forces. This design allows a train vehicle to operate on steeper grades, around 10% to 15%.

UDOT evaluated four potential alignments for cog rail from the Salt Lake Valley to the Snowbird and Alta ski resorts (for more information about each alternative, see Appendix F, Draft Rail Transit Concepts Initial Feasibility Study):

- **Cog Rail Alternative 1** – Expanded parking and rail base station at the entrance of Little Cottonwood Canyon a distance of about 8 miles to the Alta ski resort.
- **Cog Rail Alternative 2** – Expanded parking and a rail base station at a mobility hub located at the gravel pit (near Wasatch Boulevard and Fort Union Boulevard) a distance of about 12.2 miles to the Alta ski resort.
- **Cog Rail Alternative 3** – Expanded parking and a rail base station at a mobility hub near 9400 South (S.R. 209) and Highland Drive a distance of about 11.5 miles to the Alta ski resort.
- **Cog Rail Alternative 4** – UDOT also evaluated two options to connect to the existing TRAX system and avoid having to construct a large rail base station at a mobility hub with a 2,500-car parking structure. The two options for Concept 4 are:
  - **Cog Rail Alternative 4, Option A** – This option would connect a cog rail system to the existing TRAX system at the Midvale Fort Union TRAX Station (S.R. 190 and 7200 South) a distance of 18.1 miles to the Alta ski resort.
  - **Cog Rail Alternative 4, Option B** – This option would connect a cog rail system to the existing TRAX system at the Historic Sandy TRAX Station (at 9000 South and about 150 East) a distance of about 14.3 miles to the Alta ski resort.

Figure 2-13 shows the cog rail alternatives considered.

Figure 2-13. Cog Rail Alternatives



Cog Rail Alternatives Comparison

Table 2-13 compares the major feasibility criteria for the preliminary cog rail alternatives that were evaluated.

Table 2-13. Cog Rail Capital Cost, O&M Cost, and Travel Time Comparison

Cog Rail Alternative	Capital Cost (billion $)	Annual O&M Cost (million $)	Total Travel Time to Alta (minutes)
1	1.19 – 1.46	0.63	42
2	1.68 – 1.95	0.96	44
3	1.36 – 1.63	0.90	42 [a]
4A	2.09 – 2.44	1.42	54 [a,b]
4B	1.47 – 1.73	1.12	43 [a,b]

[a] Total travel times does not include any personal vehicle travel time.

[b] Total travel time does not include parking and loading times, and travel time is from the connection to UTA's TRAX system.

In addition to comparing the alternatives in terms of their travel time and capital and O&M costs, UDOT also compared the alternatives in terms of feasibility criteria pertaining to the purpose of the S.R. 210 Project (improved mobility and improved neighborhood access). UDOT also included feasibility criteria pertaining to impacts to congestion, need for roadway improvements, and expected ridership.

Impacts on Congestion. There is an existing park-and-ride lot at the entrance of Little Cottonwood Canyon at the intersection of S.R. 210 and S.R. 209. The existing lot has about 160 spaces. An expanded parking lot at or near this location, which could accommodate the assumed cog rail ridership, would require a large, multilevel parking structure. UDOT initially assumes that a 2,500-car parking structure would be required to meet the daily demand for the number transit riders entering the canyon.

Expanding the parking at the entrance to Little Cottonwood Canyon would not improve traffic congestion at the intersection of S.R. 209 and S.R. 210. A large parking structure at the base of the canyon, which would be needed with Cog Rail Alternative 1, would not improve congestion on S.R. 210 and S.R. 209 during peak arrival times. The congestion would be similar to the current conditions with traffic trying to enter the canyon. One of the purposes of the S.R. 210 Project is to reduce congestion-related access issues for residents who live at the base on the canyon (not being able to arrive at or leave their neighborhoods on peak ski days). Therefore, Cog Rail Alternative 1 would have a high impact under this criterion because it would not improve congestion.

Moving the parking and rail base station to a mobility hub located away from the entrance of the canyon (Cog Rail Alternatives 2 and 3) would benefit residents' mobility by removing some cars from the residential area. Cog Rail Alternative 2, which places the parking structure at the gravel pit and therefore closer to an interstate freeway (I-215) is better than Cog Rail Alternative 3, which is about miles from 3 miles from Interstate 15 (I-15). With Cog Rail Alternative 2, personal vehicles would travel past more residential areas to access the parking structure at the 9400 South and Highland Drive mobility hub. For train riders using their personal vehicle for the initial stages of their trip, parking for Cog Rail Alternative 4 (connections to the existing TRAX system) could be more dispersed, and Cog Rail Alternative 4 would not concentrate traffic to just one parking area.

Needed Roadway Improvements and Impacts on Travel Patterns. Implementing a cog rail line outside Little Cottonwood Canyon would require major roadway infrastructure improvements and would change travel patterns on the existing roadway network. There are many residential areas adjacent to the rail alignments outside Little Cottonwood Canyon. A center-running rail line would limit left turns out of these neighborhoods. Drivers who want to make a left-hand turn would be required to turn right, travel to a signalized intersection, and make a left U-turn or make a loop along other routes. The complicated details of the changed travel patterns through all cog rail alternative segments was not evaluated. In general, cog rail alignments that run down the center of S.R. 210 (Wasatch Boulevard), S.R. 209 (9400/9000 South), and S.R. 190 (Fort Union Boulevard) would require extensive roadway widening, would have high impacts to the existing utility infrastructure, and would change the travel patterns to and from residential and commercial areas that abut these arterial roads. Cog Rail Alternative 1 would rank as low, Cog Rail Alternatives 2 and 3 as medium, and Cog Rail Alternatives 4A and 4B as high under this criterion.

Improving Mobility and Maximizing Transit Ridership. One way to improve mobility is by providing additional transportation modes. A cog rail line would address wintertime mobility primarily by shifting a substantial portion of the future travel demand to mass transit and possibly would avoid the need to add automobile capacity in the canyon. As described in this report, UDOT's initial evaluation assumes that a percentage of the peak hourly demand could be accommodated by a cog rail system, and that all rail alternatives are essentially equal in this regard. The actual expected ridership would be based on many factors including travel time benefits and pricing.

In general, if a Little Cottonwood Canyon cog rail line were connected to UTA's existing, and expansive, light-rail network, there would be more potential riders in proximity to the existing park-and-ride lots, and this might make the transit portion of the trip attractive to more users. However, until all rail vehicles become equipped with cog equipment, riders would need to shift travel modes from standard light-rail vehicles that operate over the existing network to a cog rail vehicles that can navigate the grades in the canyon. This need to shift travel modes could reduce ridership.

Table 2-14 compares the preliminary cog rail alternatives according to the evaluation criteria.

Table 2-14. Comparison of Costs, Travel Time, and Additional Feasibility Criteria for the Preliminary Cog Rail Alternatives

Cog Rail Alternative	Costs		Travel Time	Additional Feasibility Criteria[a]		
	Capital Cost (billion $)	Annual O&M (million $)	Travel Time to Alta (minutes)	Impacts to Traffic Congestion	Roadway Improvements and Impacts on Existing Travel Patterns	Expected Ridership
1	1.2 to 1.5	0.63	42	High	Low	High
2	1.7 to 2.0	0.96	44	Low	Medium	High
3	1.4 to 1.6	0.90	42	Medium	Medium	High
4A	2.1 to 2.4	1.42	54	Low	High	Medium
4B	1.5 to 1.7	1.12	43	Low	High	Medium

[a] High impact means that the impact is greater, such as heavier congestion, a greater need for roadway improvements, or less ability to attract riders because the system is not connected to regional light rail network. Low impact means less congestion, fewer needed roadway improvements, and a greater ability to attract riders because there would be a connection to the regional light rail network.

As part of evaluating the preliminary cog rail alternatives, UDOT looked at the preliminary impacts to key resources to better understand each cog rail alternative. Table 2-15 shows the resources evaluated for Cog Rail Alternatives 1, 2, 3, and 4B.

Cog Rail Alternative 4A (cog rail from the Midvale Fort Union TRAX Station using Fort Union Boulevard and then Wasatch Boulevard) was not evaluated. The impacts from Cog Rail Alternative 4A would add to the impacts of Cog Rail Alternative 2, which would have the highest number of home acquisitions. In addition, Cog Rail Alternative 4A has the highest cost because it has the longest travel distance, but it would not provide any additional benefit to connecting to UTA's existing TRAX system compared to Cog Rail Alternative 4B.

Table 2-15. Selected Resources Evaluated for the Preliminary Cog Rail Alternatives

Impact Criterion	Unit	Alternative				
		1	2	3	4B	4A[c]
Natural Environment[a]						
Wetlands[b]	Acres	0.00	0.65	0.00	0.00	Not applicable
Streams	Acres	0.19	0.22	0.19	0.19	
Floodplains	Acres	0.00	4.81	0.07	0.07	
Impacts to wilderness areas	Acres	0.00	0.00	0.00	0.00	
Built Environment[a]						
Recreation sites	Number	6	6	6	7	Not applicable
Residential relocations	Number	2	63	40	48	
Business relocations	Number	0	0	0	2	
Cost of alternative in 2020 (in 2019 dollars)	Dollars (billions)	$1.2 – $1.5	$1.7 – $2.0	$1.4 – $1.6	$1.5 – $1.7	$2.1 – $2.4

[a] The acreage or number of impacts is based on a screening-level design. The actual impacts could decrease or increase based on more-detailed design conducted for the alternatives that pass Level 2 screening.

[b] The wetlands are associated with constructed stormwater-management facilities and might not be jurisdictional wetlands. The final determination of wetland jurisdiction will be made by the U.S. Army Corps of Engineers.

[c] Cog Rail Alternative 4A (cog rail from the Midvale Fort Union TRAX Station using Fort Union Boulevard and then Wasatch Boulevard) was not evaluated. The impacts from Cog Rail Alternative 4A would add to the impacts of Cog Rail Alternative 2, which would have the highest number of home acquisitions. In addition, Cog Rail Alternative 4A has the highest cost because it has the longest travel distance, but it would not provide any additional benefit to connecting to UTA's existing TRAX system compared to Cog Rail Alternative 4B.

Cog Rail Alternative Selected for Level 1 Screening

Based on the above analysis, UDOT carried forward **Cog Rail Alternative 4B**, cog rail connected to the existing Historic Sandy TRAX Station, for Level 1 screening. Cog Rail Alternative 4B was selected because the travel time is comparable to that of other alternatives, the alternative would have low impacts on traffic congestion, and the alternative would connect to UTA's existing light-rail network, thereby providing the opportunity for users to board the system from locations all over the Salt Lake Valley.

Comparing Cog Rail Alternative 4B to Cog Rail Alternative 2, the first alternative has a slightly lower cost (based on conceptual-level design), fewer home acquisitions, and a substantial advantage by connecting to UTA's existing light-rail network. Although Cog Rail Alternative 4B has a slightly higher cost and home acquisitions than Cog Rail Alternative 3, Cog Rail Alternative 4B has the advantage of connecting to UTA's existing light-rail network. In addition, Cog Rail Alternative 3 would require a 10-acre maintenance facility to be located near the cog rail alignment along 9400 South in a mostly residential areas, whereas Cog Rail Alternative 4B could potentially use UTA's existing maintenance facilities with some expansion.

Cog Rail Alternative 1 has the lowest costs, fastest travel times, lowest impacts to the existing roadway network, no impacts to existing travel patterns outside Little Cottonwood Canyon, and the least amount of residential impacts. However, Cog Rail Alternative 1 would require expanding the parking at the entrance to Little Cottonwood Canyon. A large parking structure at the base of the canyon, which would be needed with Cog Rail Alternative 1, would not help relieve congestion on S.R. 210 and S.R. 209 during peak arrival times. The congestion would be similar to the current conditions with traffic trying to enter the canyon. One of the purposes of improving mobility on S.R. 210 is to reduce congestion-related access issues for residents who live at the base on the canyon (not being able to arrive at or leave their neighborhoods on peak ski days). In addition Cog Rail Alternative 1 would require a parking garage that would require about 4 to 5 acres and an additional approximately 10-acre maintenance facility near the S.R. 210/S.R. 209 intersection for the cog rail in a residential area with limited land availability. Because it would not meet the project purpose of reducing congestion at the S.R. 209/S.R. 210 intersection, Cog Rail Alternative 1 was not carried forward for Level 1 screening.

2.2.2.2.4 Aerial Transit or Express Bus from Park City Alternative

As one possibility for improving mobility on S.R. 210 from Fort Union Boulevard to Alta, UDOT evaluated a preliminary alternative that would provide aerial transit or express bus service from Park City to the Snowbird and Alta ski resorts.

The Aerial Transit or Express Bus from Park City Alternative assumes that, by providing gondola or express bus service from Park City to the ski resorts in Little Cottonwood Canyon, vehicle traffic would be reduced enough that no additional roadway capacity would be needed. To evaluate this alternative, UDOT needed to determine the number of vehicles making the trip from Park City to Little Cottonwood Canyon during the peak hour. To determine the number of vehicles, UDOT conducted an origin-destination (OD) study using data from StreetLight Data. StreetLight Data is a data vendor that processes vehicle location-based data from smartphones and other navigation devices in connected cars and trucks for transportation planning purposes. OD analyses are conducted to understand travel patterns associated with trips from a given origin location to a determined destination location. For this analysis, UDOT used the StreetLight Insights web software platform (see Appendix G, Park City to Little Cottonwood Canyon Traffic Analysis).

As shown in Table 2-16, the OD data showed that between 7% and 8.5% of the morning traffic into Little Cottonwood Canyon is from Park City, or an average of 7.8% (HDR 2019a). For the mobility screening analysis to determine travel times per person, UDOT is using the 30th-busiest day in 2050 (see Section 2.2.2.3, Level 1 Screening), which is about 1,555 vehicles in the peak hour into Little Cottonwood Canyon. If a gondola or express bus system from Park City were built, on average about 121 vehicles could be eliminated from Little Cottonwood Canyon ski traffic during the peak hour, which would reduce peak-hour traffic to about 1,434 vehicles. The analysis of the 7.5-minute bus headway option showed that 1,370

vehicles per hour would back up on S.R. 210 and S.R. 209, which would be similar to backups with the No-Action Alternative. Therefore, reducing the peak-hour traffic to about 1,434 would also result in vehicle backups on S.R. 210 and S.R. 209 similar to the No-Action conditions in 2050. Because the Aerial Transit or Express Bus from Park City Alternative would cause similar vehicle backups on S.R. 210 and S.R. 209 as the 2050 No-Action Alternative, it was not carried forward for Level 1 screening.

Table 2-16. Peak Morning Traffic from Park City to Little Cottonwood Canyon

Days	Period	Percent Peak Winter Traffic (2019)	Vehicles during Peak Hour of 30th-busiest Day (2050)	
			Total Vehicles in Canyon	Estimated Vehicles from Park City
Monday–Sunday	Peak AM (7 AM–11 AM)	7.8%	1,555	121
Monday–Thursday	Peak AM (7 AM–11 AM)	8.5%	1,555	132
Friday–Sunday	Peak AM (7 AM–11 AM)	7.0%	1,555	109

2.2.2.2.5 Mobility Hub Alternatives

To support personal vehicle parking for the transit alternatives (bus, aerial transit, and rail transit), UDOT evaluated suitable locations for a mobility hub. For the transit alternatives, UDOT considered comments provided during scoping about mobility hub locations. For more information, see Appendix H, Draft Evaluation of Mobility Hub Locations.

What is a mobility hub?

A mobility hub is a location where users can transfer from a personal vehicle to a bus.

As shown in Table 2-17, UDOT evaluated 14 potential locations for a mobility hub to service Little Cottonwood Canyon. The mobility hub locations could be used for bus service directly to the ski resorts or for bus service to a train or gondola station located at the entrance to Little Cottonwood Canyon. Table 2-17 shows the results of the evaluation. Based on the alternatives screening summarized in Table 2-17 and described in Appendix H, UDOT determined that the best locations for mobility hubs were the **gravel pit on the east side of Wasatch Boulevard between 6200 South and Fort Union Boulevard** and the **UTA park-and-ride lot at 9400 South and Highland Drive**. Both locations meet the lot size and availability requirements and would provide convenient access for users and transit to Little Cottonwood Canyon. These locations were used with each bus and gondola alternative to help evaluate each transit alternative.

Table 2-17. Preliminary Screening Results – Mobility Hub Alternatives

Alternative	Screening Criteria (Green = Pass, Red = Eliminated)				
	Available[a] (Yes/No)	Convenient Access[b] (Yes/No)	Lot Size[c]	Pass Screening (Yes/No)	Notes
Little Cottonwood Canyon Park-and-Ride	Yes	Yes	1.3 acres	No	Lot size is too small to accommodate parking requirements and would result in potential traffic congestion at the S.R. 209/S.R. 210 intersection similar to existing conditions.
Big Cottonwood Canyon Park-and-Ride	Yes	Yes	1.6 acres	No	Lot size is too small to accommodate parking requirements.
9400 South/ Highland Drive Park-and-Ride	Yes	Yes	4 acres	**Yes**	**Carried forward for Level 1 Screening**
6200 South/ Wasatch Blvd. Park-and-Ride	Yes	Yes	1.6 acres	No	Lot size is too small to accommodate parking requirements Little Cottonwood Canyon.
Reams Market at 7200 South	No	Yes	500 parking stalls	No	Currently in use for commercial business. Lot would not be available.
Tree Farm off of Wasatch Blvd.	Yes	No	28.9 acres	No	The lot includes steep train that may make construction difficult. In addition, the lot would but a high level of traffic in residential area and would be located in a residential area which would not be compatible with a parking structure.
3662 North Little Cottonwood Canyon Rd	Yes	No	6.85 acres	No	Location would cause congestion on Wasatch Boulevard during peak use times in a residential area similar to current conditions. Land is between two residential subdivisions which would not be compatible with parking structure.
Swamp Lot	Yes	No	2.1 acres	No	Lot size is too small to accommodate parking requirements for Little Cottonwood Canyon.
Lower Canyon	Yes	No	6.5 acres	No	The lot would impact a heavily used Little Cottonwood Canyon hiking trail and would be immediately adjacent to Little Cottonwood Canyon Creek. Lot would result in potential traffic congestion at the S.R. 209/S.R. 210 intersection similar to existing conditions.

(*continued on next page*)

Table 2-17. Preliminary Screening Results – Mobility Hub Alternatives

Alternative	Screening Criteria (Green = Pass, Red = Eliminated)				
	Available[a] (Yes/No)	Convenient Access[b] (Yes/No)	Lot Size[c]	Pass Screening (Yes/No)	Notes
School and Church Parking Lots	No	No	Not applicable	No	Church lots would not be available on Sundays and some weekends during special events. School lots might not be available during weekdays, weekends during special events, and some holidays.
Existing Business Parking at I-215/ 6200 South	No	Yes	3,000 parking stalls	No	An agreement with the owner would need to be reached to allow use and address liability concerns. Lot might not be available on weekdays and holidays.
Gravel Pit	Yes	Yes	65 acres	**Yes**	**Carried forward for Level 1 screening**
Mall Parking – Holladay	Yes	No	48 acres	No	Area does not have convenient freeway access. Would increase transit travel times and out-of-direction travel for users.
Mall Parking – Fashion Place	No	Yes	4,900 parking stalls	No	Currently in use for commercial business and would not be available on weekdays, weekends, and holidays.

[a] The alternative must be available on weekdays, weekends, holidays, heavy snow days, and extended vacation periods (for example, the Christmas, Presidents' Day, and Easter holidays).

[b] The alternative must provide convenient access to traffic from the south end and north ends of the Salt Lake Valley, reduce out-of-direction travel, reduce potential traffic conflicts with residential traffic, and provide convenient bus access to Little Cottonwood Canyon.

[c] For new or existing mobility hub locations, the area must be 4 acres or must accommodate about 680 to 1,440 parking stalls. One or more sites could meet this need.

2.2.2.3 Level 1 Screening

2.2.2.3.1 Level 1 Screening Alternatives

Based on UDOT's evaluation of the preliminary alternatives for improving mobility on S.R. 210 from Fort Union Boulevard to Alta, the following alternatives were eliminated from further consideration and were not carried forward for Level 1 screening:

- Double Stacking Alternative
- S.R. 209 Roundabout Alternative
- Reversible-lane Alternative with Moveable Barrier
- Reversible-lane Alternative with Overhead Lane-control Signs
- Bus-only Alternative
- Regional Shuttle Bus System Alternative
- Aerial Transit or Express Bus from Park City Alternative

The alternatives that were carried forward for Level 1 screening are shown in Table 2-18. All of the alternatives in Table 2-18 include widening Wasatch Boulevard for the reasons explained in Section 2.1, Improve Mobility on Wasatch Boulevard. All of the alternatives listed in the table would need to include a toll or other travel management strategy such as a prohibition on single-occupant vehicles during peak travel periods in Little Cottonwood Canyon in order to promote transit use (bus, gondola, or rail).

Table 2-18. Level 1 Screening Alternatives – S.R. 210

Alternative	Personal Vehicles in the Peak Hour [a]	Transit Vehicles in the Peak Hour	People in Personal Vehicles in the Peak Hour	People in Transit in the Peak Hour	Total People in the Peak Hour [b]
Additional Roadway Capacity To Wasatch Boulevard with no additional capacity on S.R. 210 in Little Cottonwood Canyon Road and Increase Transit (Bus, Gondola, And Train)					
1. Enhanced Bus Service A1 – 16 buses per hour during peak period • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – One lane each direction • Transit – 16 buses per hour during peak period (every 3.45 minutes or every 7.5 minutes per resort)	1,368	16	2,585	672	3.257
2. Enhanced Bus Service B1 – 24 buses per hour during peak period • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – One lane each direction • Transit – 24 buses per hour during peak period (every 2.30 minutes or every 5 minutes to each resort)	1,190	24	2,249	1,008	3,257
3. Gondola (selected aerial transit alternative) • Wasatch Boulevard – 4 or 5 lanes • Little Cottonwood Canyon – One lane each direction • Gondola –30 gondolas (minimum) per hour during peak period (every 2 minutes)	1,190	30	2,249	1,050	3,299
4. Cog Rail (selected rail transit alternative) • Wasatch Boulevard – 4 or 5 lanes • Little Cottonwood Canyon – One lane each direction • Cog rail vehicles – 4 trains per hour during peak period (every 15 minutes)	1,190	4	2,249	1,012	3,261

(*continued on next page*)

Table 2-18. Level 1 Screening Alternatives – S.R. 210

Alternative	Personal Vehicles in the Peak Hour [a]	Transit Vehicles in the Peak Hour	People in Personal Vehicles in the Peak Hour	People in Transit in the Peak Hour	Total People in the Peak Hour [b]
Additional Roadway Capacity to Wasatch Boulevard and Peak-period Shoulder Lanes on S.R. 210 in Little Cottonwood Canyon with Bus Service					
5. Enhanced Bus Service A2 – 16 buses per hour during peak period • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – bus-only peak-period shoulder lane[c] • Transit – 16 buses per hour during peak period (every 3.45 minutes or every 7.5 minutes per resort)	1,368	16	2,585	672	3,257
6. Enhanced Bus Service B2 – 24 buses per hour during peak period • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – bus-only peak-period shoulder lane[c] • Transit – 24 buses per hour during peak period (every 2.30 minutes or every 5 minutes to each resort)	1,190	24	2,249	1,008	3,257

[a] Assumes 1.89 people per vehicle during the peak hour based on occupancy counts conducted in 2018.

[b] Peak-hour person demand for any alternative would need to be equal or greater than 3,250 to meet the demand during the 30th-busiest hour in 2050.

[c] The peak-period shoulder lane would be a cyclist and pedestrian lane in the summer or would not be in use.

2.2.2.3.2 Level 1 Screening Criteria

The alternatives that were evaluated in Level 1 screening for improving mobility on S.R. 210 were evaluated against the criteria in Table 2-19. The criteria focused on improving overall mobility and reducing congestion on S.R. 210.

Table 2-19. Level 1 Screening Criteria – S.R. 210

Criterion	Measure
Improve mobility in 2050	• Substantially improve peak-hour per-person (defined as the 30th-busiest hour) travel times in Little Cottonwood Canyon for uphill and downhill users in 2050 compared to travel times with the No-Action Alternative. • Meet peak-hour average total person demand on busy ski days in Little Cottonwood Canyon. • Substantially reduce vehicle backups on S.R. 210 and S.R. 209 through residential areas on busy ski days (30th-busiest day).

2.2.2.3.3 Level 1 Screening Methodology

For more information about the methodology, see Appendix I, Draft Vehicle Mobility Analysis.

Peak Travel Hour Used in the Analysis. To determine travel times for the roadway alternatives, UDOT used a busy ski day peak hour as the design hour. A design hour is an hour with a traffic volume that represents a location-specific peak-hour value for designing the geometric and control elements of a road. This selected peak hour will allow the designed facility to accommodate traffic during most of the peak hours. The design hour is a key characteristic in estimating the expected demand for a proposed transportation facility. Typically, the hour corresponding to the 30th-highest hourly traffic volume of the year is considered as the design hour as stated by the Highway Performance Monitoring System (HPMS). In rural settings similar to S.R. 210 in Little Cottonwood Canyon, customary practice in the United States is to base highway design on the 30th-highest hour of the year. The 30th-highest hour is used because it falls in the range of subsequent highest hours that have similar traffic volumes. Even though a considerable variance is observed between the peak (highest) and 30th-highest hourly traffic volumes of a year, designing for the peak hour would not be deemed economical and feasible in many regions (FHWA 2018).

In 2017, the 30th-highest peak-hour eastbound traffic on S.R. 210 at the entrance to Little Cottonwood Canyon was 1,061 vehicles, which occurred in the morning. The 30th-highest peak-hour westbound traffic was 1,051 vehicles, which occurred in the afternoon (Fehr & Peers 2018a). To obtain 2050 30th-highest peak-hour traffic volumes, a 1.2% growth rate was applied based on historical growth rates for a 22-year period starting in 2018 and ending in 2050 (Fehr & Peers 2018b). Based on expected traffic growth and growth in regional population (see Table 2-3, Projected Regional Population, Employment, and Household Growth, above), the 30th-highest peak hour would be about 1,555 vehicles. Therefore, UDOT used the estimate of 1,555 vehicles per hour for the screening analysis to determine vehicle travel times. The 1,555 vehicles per hour was used for both uphill and downhill peak hours because traffic data from 2017 showed a similar level of travel demand during the AM and PM peak hours.

To determine the number of persons per peak hour, UDOT used the average occupancy per vehicle based on 2018 occupancy data for the peak morning hour weekend day of 1.89 occupants per vehicle and 42 occupants per bus. For buses, the current 15-minute headways from two bus routes (8 buses total per hour) was assumed. The results show that, under No-Action conditions in the peak morning hour, about

336 people would travel by bus and 2,924 would travel by car, for a total of about 3,260 people trying to enter Little Cottonwood Canyon in the peak hour on the 30th-busiest day in 2050.

Travel Time Analysis Criteria. To measure the mobility criteria to reduce travel time, UDOT used a reduction in travel time per person as the measure. This criterion would show the benefit for all users independent of traveling in a personal car or bus. For example, if a dedicated bus lane were implemented with a faster travel time for a bus than a personal vehicle, the 42 persons in the bus would have a faster travel time than the 2 people in the personal vehicle, thereby giving a greater benefit to bus service.

To provide an equal travel time comparison, common points of travel were selected for all travel modes. Travel used in the analysis was from Fort Union Boulevard and Wasatch Boulevard to the Alta Ski resort. For vehicles, the travel time would start at Fort Union Boulevard and end at the Alta ski resort. For buses and gondolas, the travel time would start at Fort Union Boulevard but would also include time to transfer from one mode to another. For the cog rail alternative, the travel time starts at the Sandy City Expo TRAX Station with no transfer times since UDOT assumed that most users would be using the existing light-rail system. Transfer mode time between parking a vehicle and transit leaving the mobility hub was assumed to be 12 minutes (Table 2-20). For example, if there was a bus parking garage at the entrance to Little Cottonwood Canyon, the total travel time would include the time to travel by vehicle from Fort Union Boulevard to the entrance of Little Cottonwood Canyon, a mode transfer time from vehicle to bus of 12 minutes, then the bus travel time to Alta.

Table 2-20. Vehicle to Transit Transfer Time Assumptions

Travel Time Description	Time in Minutes
Wait to enter parking garage	0.5
Find parking spot	1
Unload gear and put gear on (boots, jackets, helmet, etc.)	4
Fare collection	1
Walk from vehicle to transit wait area[a]	3.5
Wait for transit	2
Total transit parking and transfer time	**12**

[a] Walk speed assumed to be 3 miles per hour or 264 feet per minute. Distance from parking spot to transit wait area assumed at 900 feet for a total walk time of 3.41 minutes. Walk time rounded to 3.5 minutes.

For this analysis, the overall travel time reduction had to be substantially better that the 2050 No-Action vehicle/bus per-person travel time from Fort Union Boulevard to Alta of between 80 and 85 minutes.

Travel Time Modeling. The Little Cottonwood Canyon Sketch Planning Tool (SPT or model) is a data-driven planning tool designed for Little Cottonwood Canyon to estimate travel times in the canyon based on changes in travel demand and potential transportation improvements. The SPT is a system dynamics model. System dynamics models are applicable to systems that have many individually dynamic components which are interrelated. The SPT focuses on relationships between travel demand in Little Cottonwood Canyon, mode choice, and travel times. Each approach to the canyon and the roadway within Little Cottonwood

Canyon is programmed into the model, along with the existing number of travel lanes, and the posted speed limits (HDR 2019b).

The model begins analyzing traffic outside the canyon on S.R. 210 from the intersection with Fort Union Boulevard to the Alta ski resort. The SPT is able to adjust the overall daily travel demand for the canyon (the number of people who enter the canyon on a given day), hourly arrival times, modes of transportation used by each person, bus headways and ridership capacities, and parking lot capacities throughout the canyon.

The SPT evaluates changes to the entire study area and estimates the potential travel times. A variety of scenarios can be evaluated, including combinations of the following:

- Changing the number of travel lanes
- Changing speed limits
- Creating a transit-only (bus-only) lane
- Creating an HOV (high-occupancy vehicle) lane for buses and carpooling vehicles
- Changing the bus schedule(s) or route(s)
- Changing the mode of transportation used by each person (that is, more people carpool or take the bus)
- Changing the time of day when people arrive at or leave the canyon as a result of road closure from avalanche-control activities

For this analysis, the SPT was used to calculate travel times for vehicles and buses and the number of single occupant vehicle, high occupancy vehicle, and bus users.

Vehicle Backup into Neighborhoods Analysis Criteria. One of the screening criteria is to substantially reduce vehicle backups on S.R. 210 and S.R. 209 through residential areas on busy ski days. For this analysis, a VISSIM model was used to determine the length of vehicle backup from the S.R. 209/S.R. 210 intersection for each alternative evaluated. The analysis is based on UDOT's *Traffic Analysis Guidelines* (UDOT 2018c). The backup length criteria used in the analysis is the 95th-percentile vehicle queue, which is defined to be the vehicle queue length that has only a 5% probability of being exceeded during the analysis period. The length is measured from the stop bar of an intersection or from the beginning of a roadway bottleneck to the end of the last vehicle in the line. The screening criterion is that an alternative would substantially reduce vehicle backups compared to 2050 No-Action conditions. In 2050, the vehicle backups during the 30th-busiest design hour on S.R. 209 are projected to be past the traffic signal at 9400 South and Wasatch Boulevard, and the vehicle backups on S.R. 210 are projected to be past the traffic signal at Wasatch Boulevard and North Little Cottonwood Road.

Tolling. The analysis assumes that, to incentivize use of the Level 1 alternatives (buses, gondola, or cog rail), UDOT would need to implement a travel demand management strategy of a toll or a prohibition on single-occupant vehicles. For tolling to be effective in reducing congestion on S.R. 210 with these alternatives, the analysis assumed that the toll would be high enough that about 30% of vehicle traffic would divert to transit. Similarly, eliminating single-occupant vehicles would divert about 30% of traffic to transit.

2.2.2.3.4 Level 1 Screening Results

Table 2-21 shows the per-person travel time (Fort Union Boulevard to Alta ski resort), the S.R. 209 and S.R. 210 vehicle backup lengths, and the results of Level 1 screening for each alternative. Red cells in the table indicate performance measures that did not pass Level 1 screening. All alternatives were designed to meet the peak-hour demand of about 3,250 persons traveling eastbound on S.R. 210 and assume a widened Wasatch Boulevard. The analysis shows that all alternatives would substantially reduce travel time compared to 2050 No-action conditions; however, alternatives 1 and 5 (Enhanced Bus Service A1 and A2) would not substantially reduce vehicle backups on S.R. 209 and S.R. 210 compared to the 2050 No-Action baseline and therefore do not pass Level 1 screening. All of the other alternatives would substantially reduce travel time and backups on S.R. 209 and S.R. 210 and therefore pass Level 1 screening. Figure 2-14 shows the vehicle backups on S.R. 209 and S.R. 210 for the alternatives evaluated in Level 1 screening.

Based on the analysis, **Alternatives 2, 3, 4, and 6** passed Level 1 screening and were carried forward for Level 2 screening.

Table 2-21. Level 1 Screening Results – S.R. 210

Alternative	Personal Vehicles in Peak Hour [b]	Transit Vehicles in Peak Hour	People in Personal Vehicles in Peak Hour	People in Transit in Peak Hour	Screening Results (Red indicates does not pass and green pass)				
					Meet Peak-Hour Person Demand (total people per hour)[d]	Substantially Improve Peak-hour Travel Time per Person eastbound/westbound (minutes)[e]	Substantially Reduce Vehicle Backups at S.R. 209/S.R. 210 Intersection	Meet LOS A-D in AM and PM Weekday Peak-hour on Wasatch Blvd.	Pass Level 1 Screening Yes/No
2050 No-Action (baseline)[a] • Wasatch Boulevard – One lane each direction • Little Cottonwood Canyon – One lane each direction • Transit – 15-minute bus headways	1,547	8	2,924	336	3,260	80–85/80–85 (80–85 – vehicle and bus)	6300 + (Beyond Signals at 9400 S/Wasatch Boulevard intersection)/8500 + (Beyond Signals at Wasatch Boulevard/North Little Cottonwood Road intersection)	LOS F	N/A
Additional Roadway Capacity to Wasatch Boulevard with No Additional Capacity to S.R. 210 in Little Cottonwood Canyon and Increase Transit (Bus, Gondola, And Train)									
1. Enhanced Bus Service A1 – 16 buses per hour during peak period [c] • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – One lane each direction • Transit – 16 buses per hour during peak period (every 3.45 minutes entering the canyon or every 7.5 minutes per resort)	1,368	16	2,585	672	3.257	50–55 / 50–55 (50–55/50–55 – vehicle) (60–65/60–65 – bus)	3,400 / 8500 + (Beyond Signals at Wasatch Boulevard/North Little Cottonwood Road intersection)	LOS C/D	No
2. Enhanced Bus Service B1 – 24 buses per hour during peak period [c] • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – One lane each direction • Transit – 24 buses per hour during peak period (every 2.30 minutes entering the canyon or every 5 minutes to each resort)	1,190	24	2,249	1,008	3,257	45–50 / 45–50 (40–45/40–45 – vehicle) (50–55/50–55 – bus)	1,275/4,300	LOS C/D	Yes
3. Gondola (selected aerial transit alternative) • Wasatch Boulevard – 4 or 5 lanes • Little Cottonwood Canyon – One lane each direction • Bus to gondola at entrance of canyon –30 gondolas per hour during peak period (every 2 minutes)	1,190	30	2,249	1,050	3,299	45–50/45–50 (35–40 – vehicle) (60–65 – gondola)	350/3,050	LOS C/D	Yes
4. Cog Rail (selected rail transit alternative) • Wasatch Boulevard – 4 or 5 lanes • Little Cottonwood Canyon – One lane each direction • Double track from Historic Sandy TRAX Station to Alta • Cog vehicles – 4 per hour during peak period (every 15 minutes)	1,190	4	2,249	1,012	3,261	35–40/35–40 (35–40 – vehicle) (40–45 – train)	350/3,050	LOS C/D	Yes

(*continued on next page*)

Table 2-21. Level 1 Screening Results – S.R. 210

Alternative	Personal Vehicles in Peak Hour [b]	Transit Vehicles in Peak Hour	People in Personal Vehicles in Peak Hour	People in Transit in Peak Hour	Screening Results (Red indicates does not pass and green pass)				
					Meet Peak-Hour Person Demand (total people per hour)[d]	Substantially Improve Peak-hour Travel Time per Person eastbound/westbound (minutes)[e]	Substantially Reduce Vehicle Backups at S.R. 209/S.R. 210 Intersection	Meet LOS A-D in AM and PM Weekday Peak-hour on Wasatch Blvd.	Pass Level 1 Screening Yes/No
Additional Roadway Capacity to Wasatch Boulevard and Peak-period Shoulder Lanes on S.R. 210 in Little Cottonwood Canyon with Bus Service									
5. Enhanced Bus Service A2 – 16 buses per hour during peak period [c] • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – bus-only peak-period shoulder lane • Transit – 16 buses per hour in peak period (every 3.45 minutes or every 7.5 minutes per resort)	1,368	16	2,585	672	3,257	45–50 / 45–50 (45–50/45–50 – vehicle) (35–40/40–45 – bus)	2,450/8500 + (Beyond Signals at Wasatch Boulevard/North Little Cottonwood Road intersection)	LOS C/D	No
6. Enhanced Bus Service B2 – 24 buses per hour during peak period [c] • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – bus-only peak-period shoulder lane • Transit – 24 buses per hour during peak period (every 2.30 minutes or every 5 minutes to each resort)	1,190	24	2,249	1,008	3,257	35–40 / 35–40 (35–40/35–40 – vehicle) (35–40/40–45 – bus)	350/3,050	LOS C/D	Yes

Red-shaded cells indicate performance measures that did not pass screening, and green-shaded cells indicate measures that passed screening.

[a] No-Action Alternative serves as baseline to compare to action alternatives and is not evaluated against screening criteria.

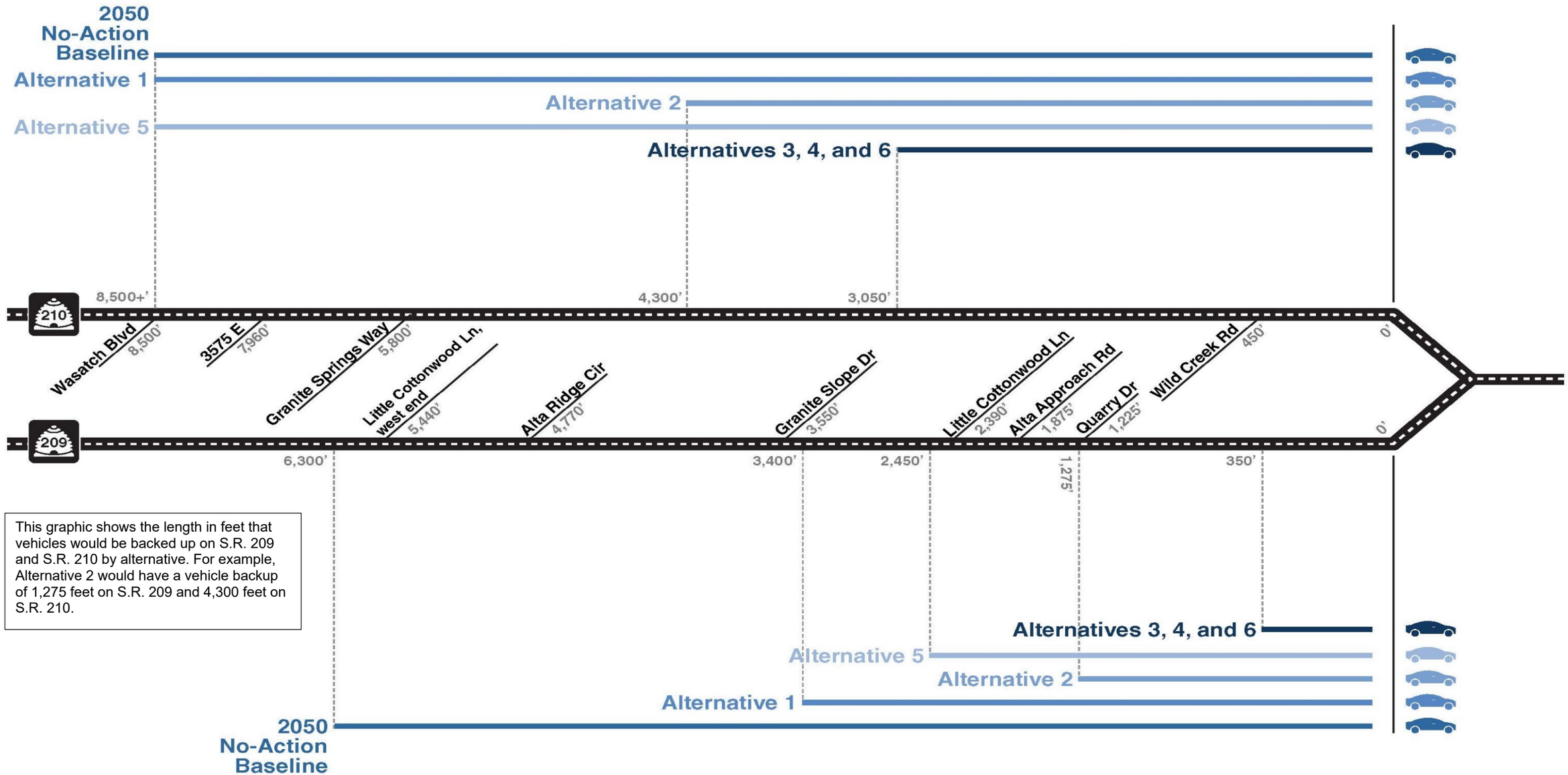
[b] Assumes 1.89 people per vehicle during the peak hour based on occupancy counts conducted in 2018.

[c] Assumes buses from mobility hubs at both the gravel pit and 9400 South and Highland. Bus standing capacity of 42 persons.

[d] Peak-hour person demand would need to be greater than 3,250.

[e] Travel times includes 12-minute vehicle to bus transfer time for bus and gondola alternatives. No transfer time was included for the cog rail alternative since it would connect to the existing light-rail network.

Figure 2-14. Vehicle Backup Lengths on S.R. 209 and S.R. 210 by Alternative



This graphic shows the length in feet that vehicles would be backed up on S.R. 209 and S.R. 210 by alternative. For example, Alternative 2 would have a vehicle backup of 1,275 feet on S.R. 209 and 4,300 feet on S.R. 210.

2.2.2.4 Level 2 Screening

As a result of Level 1 screening, the alternatives listed in Table 2-22 were carried forward into Level 2 screening.

Table 2-22. Level 2 Screening Alternatives – S.R. 210

Alternative	Personal Vehicles in Peak Hour [a]	Transit Vehicles in Peak Hour	People in Personal Vehicles in Peak Hour	People in Transit in Peak Hour	Total People in Peak hour [b]
Additional Roadway Capacity to Wasatch Boulevard with No Additional Capacity to S.R. 210 in Little Cottonwood Canyon and Increase Transit (Bus, Gondola, and Train)					
2. Enhanced Bus Service B1 – 24 buses per hour during peak period • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – One lane each direction • Transit – 24 buses per hour during peak period (every 2.30 minutes or every 5 minutes to each resort)	1,190	24	2,249	1,008	3,257
3. Gondola • Wasatch Boulevard – 4 or 5 lanes • Little Cottonwood Canyon – One lane each direction • Gondola –30 gondolas per hour during peak period (every 2 minutes)	1,190	30	2,249	1,050	3,299
4. Cog Rail • Wasatch Boulevard – 4 or 5 lanes • Little Cottonwood Canyon – One lane each direction • Cog vehicles – 4 per hour during peak period (every 15 minutes)	1,190	4	2,249	1,012	3,261
Additional Roadway Capacity to Wasatch Boulevard and Peak-period Shoulder Lanes on S.R. 210 in Little Cottonwood Canyon with Bus Service					
6. Enhanced Bus Service B2 – 24 buses per hour during peak period • Wasatch Boulevard – 4 or 5 lanes with transit priority • Little Cottonwood Canyon – bus-only peak-period shoulder lane • Transit – 24 buses per hour during peak period (every 2.30 minutes or every 5 minutes to each resort)	1,190	24	2,249	1,008	3,257

[a] Assumes 1.89 people per vehicle during the peak hour based on occupancy counts conducted in 2018.

[b] Peak-hour person demand would need to be greater than 3,250.

UDOT developed a preliminary engineering design for each alternative in order to evaluate the expected impacts for each Level 2 criterion [see Table 1-2, Level 2 Screening Criteria (Impacts), above]. Table 2-23 shows the results of Level 2 screening.

Table 2-23. Level 2 Screening Results – S.R. 210

Impact Criterion	Unit	Alternative			
		2 (Enhanced Bus B1)	3 (Gondola)	4 (Cog Rail)	6 (Enhanced Bus B2)
Natural Environment[a]					
Wetlands[b]	Acres	0.65	0.00	0.65	0.65
Streams	Acres	0.03	0.03	0.22	0.37
Critical habitat	Acres	0.00	0.00	0.00	0.00
Floodplains	Acres	3.74	1.83	3.81	5.03
Impacts to wilderness areas	Acres	0.00	0.00	0.00	0.00
Built Environment[a]					
Consistency with USDA Forest Service Plan	Yes/no	Yes	No	No	Yes
Consistency with local plans	Yes/no	Yes	No	No	Yes
Recreation sites	Number	2	2	6	6
Community facilities	Number	0	0	0	0
Residential relocations	Number	1	1	49	1
Business relocations	Number	0	0	4	0
Section 4(f) properties	Number	9	9	37	18
Historic properties	Number	7	7	31	12
Cost of alternative in 2020[c,d]	Dollars (millions)	$280–$285	$390–$400	$1,600–$1,700	$470–$475
Annual O&M cost[e]	Dollars (millions)	$9	$4.5	$1.1	$6.2

[a] The acreage or number of impacts is based on a screening-level design. The actual impacts could decrease or increase based on more-detailed design conducted for the alternatives that pass Level 2 screening.

[b] The wetlands are associated with constructed stormwater-management facilities and might not be jurisdictional wetlands. The final determination of wetland jurisdiction will be made by the U.S. Army Corps of Engineers.

[c] Cost is in 2019 dollars.

[d] All alternative costs include widening Wasatch Boulevard and tolling infrastructure. Bus alternatives and the cog rail alternative include snow sheds. The Enhanced Bus Alternative B2 includes peak-period shoulder lanes on S.R. 210 from North Little Cottonwood Road to the Alta Bypass Road.

[e] The gondola alternative's O&M cost includes cost for enhanced bus to gondola and the gondola. Enhanced Bus Alternative B2's cost includes the bus service and the extra maintenance cost to plow the peak-period shoulder lanes.

2.2.2.4.1 Level 2 Screening Results

As shown in Table 2-23 above, the impacts to the natural environment would be similar between the alternatives evaluated in Level 2 screening. The main difference between the alternatives is related to home acquisitions, Section 4(f) impacts, historic property impacts, and cost. The cog rail alternative would have 48 more home acquisitions compared to the other alternatives, the highest Section 4(f) impacts and historic property impacts, and a cost up to 3 times greater than the other alternatives. In addition, this alternative would eliminate access to two key recreation resources in Little Cottonwood Canyon (the Gate Buttress and Lisa Falls Trailheads). Because of the high number of Section 4(f) impacts, including to important recreation sites, the cog rail alternative would not be prudent under Section 4(f). Therefore, based on the high cost and impacts to residential properties and Section 4(f) properties, UDOT eliminated the cog rail alternative from further evaluation in the EIS.

The main differences among Alternatives Enhanced Bus Alternative 2, Gondola Alternative 3, and Enhanced Bus Alternative 6 are that Alternative 6 would have the highest cost and impacts to recreational resources, historic resources, and Section 4(f) resources. However, UDOT determined that the higher cost and impacts from Alternative 6 were within a reasonable range when compared to Alternatives 2 and 3 and thus decided not to eliminate Alternative 6 in the screening process. Alternatives 2 and 3 had similar impacts and cost. Therefore, based on the Level 2 screening, UDOT determined that Alternatives 2, 3, and 6 would be considered further in the EIS and that Alternative 4 would be eliminated from further consideration.

2.2.2.4.2 Alternatives Carried Forward for Further Evaluation

The following S.R. 210 alternatives will be carried forward for further evaluation in the EIS:

- **Alternative 2 – Enhanced Bus Service B1** – 24 buses per hour during the peak period
- **Alternative 3 – Gondola**
- **Alternative 6 – Enhanced Bus Service B2** – 24 buses per hour during the peak period in peak-period, shoulder-running bus lanes

3.0 Alternatives Development and Screening Process – Improve Reliability and Safety

Improving reliability on S.R. 210 is focused on safety concerns associated with avalanche hazards and trailhead parking. Avalanche hazards cause substantial traffic delays as a result of the current avalanche-control program in Little Cottonwood Canyon. Periodic road closures for avalanche control can cause 2-to-4-hour travel delays or longer, which can cause traffic to back up in the neighborhoods at the entrance of the canyon. In turn, the reliability of vehicle travel in Little Cottonwood Canyon affects the mobility on S.R. 210.

Roadside trailhead parking on the roadway shoulder and partially on segments of the road causes safety concerns and some mobility issues because the loss of shoulder area for cyclists and pedestrians forces them into the roadway travel lane and creates a safety concern with traffic. In addition, parking along the road instead of at trailheads creates informal trailheads that contribute to erosion, mineral soil loss, the spread of invasive weeds, and loss of native vegetation in the canyon. Damage to the pavement along the roadway edge caused by roadside parking also causes increased soil erosion and runoff into nearby streams.

This section describes UDOT's evaluation of alternatives to improve reliability and safety on S.R. 210 through:

- Avalanche mitigation
- Improving trailhead parking
- Eliminating winter roadside parking

3.1 Improve Reliability and Safety through Avalanche Mitigation

3.1.1 Range of Alternatives

3.1.1.1 Active versus Passive Avalanche Mitigation Alternatives

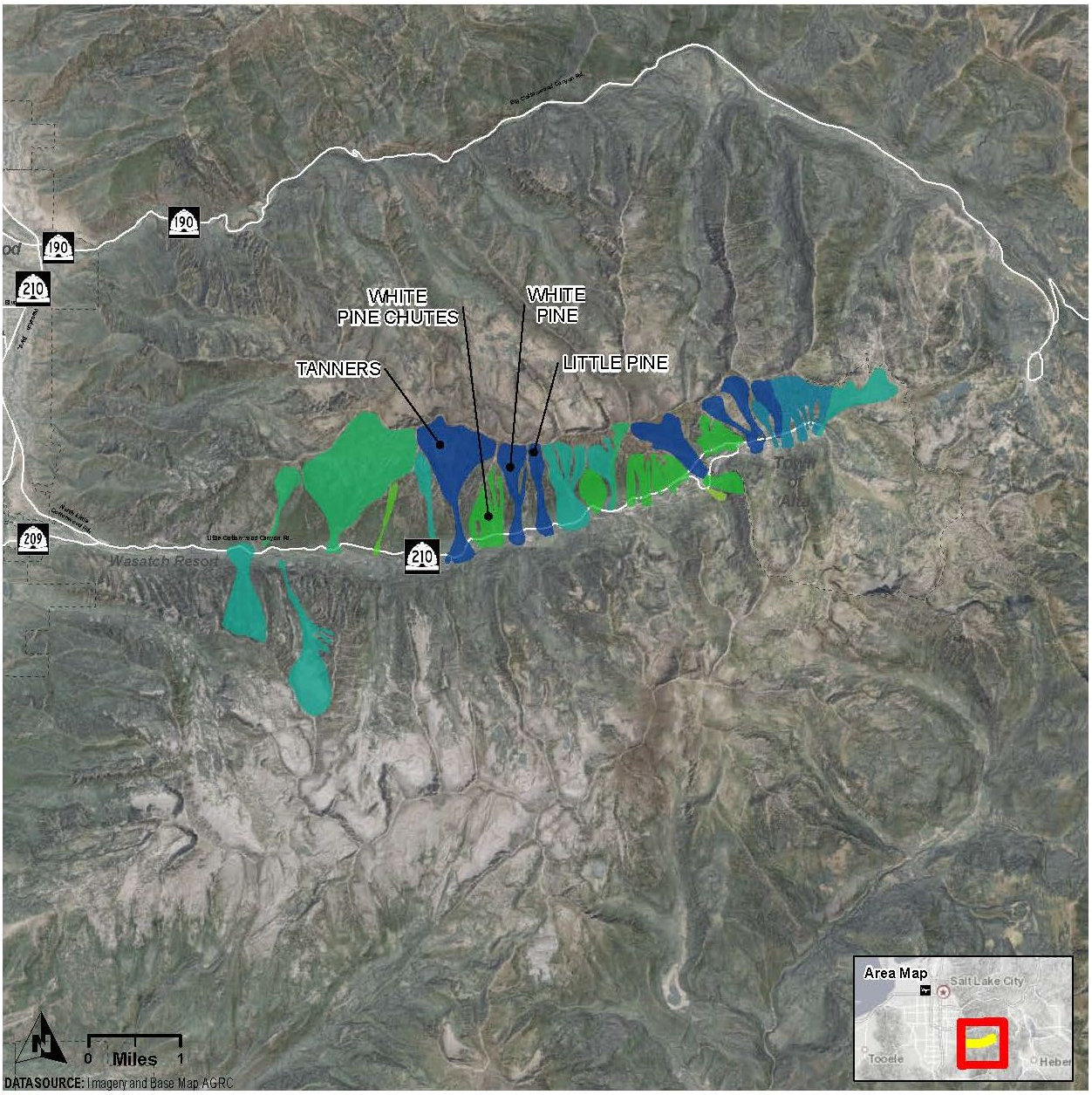
When evaluating avalanche mitigation alternatives, UDOT first considered passive and active avalanche-control measures. Active measures include blasting using artillery or explosives to create a controlled avalanche release, during which time the road is closed. UDOT currently uses active measures to control avalanches, which requires closing S.R. 210 during avalanche-control processes. Passive measures include placing snow sheds over the road, building walls to stop avalanches from impacting the road, or realigning the road outside the avalanche path. Passive measures normally do not require closing the road.

For the current analysis, one of the screening criteria for avalanche mitigation is to improve S.R. 210's reliability by substantially reducing the number of days and hours when the road is closed for avalanche mitigation and incidents. Because active measures would still require road closure during the avalanche-mitigation process (as with the existing conditions) and would not reduce the number of days or hours of closure, they were eliminated from detailed consideration. Thus, for the S.R. 210 Project, only passive measures were considered for the alternatives development and screening process. The passive avalanche mitigation alternatives considered included snow-supporting structures, snow sheds, roadway re-alignment, and deflection and stopping walls.

3.1.1.2 Avalanche Mitigation Location

The most critical avalanche paths with respect to avalanche risk in Little Cottonwood Canyon are the Tanners, White Pine Chutes, White Pine, and Little Pine avalanche paths (Figure 3-1). Therefore, the focus of the passive avalanche mitigation alternatives development process is on these avalanche paths. UDOT's active avalanche-control program in these paths consists primarily of closing the road and using artillery in a wilderness area to cause a controlled avalanche release followed by removing any snow that could impact S.R. 210. S.R. 210 is opened after the avalanche-control process is completed.

Figure 3-1. Avalanche Paths in Little Cottonwood Canyon



LEGEND

Size of Slide and Return Interval

- Minor, Occasional
- Significant, Infrequent
- Significant, Frequent
- Major, Infrequent
- Major, Occasional
- Major, Occasional to Frequent
- Major, Frequent

3.1.1.3 Avalanche Mitigation Baseline Conditions

Avalanches in Little Cottonwood Canyon present a hazard to the traveling public. Avalanche risk is measured using an avalanche hazard index (AHI), which is a numeric expression of the potential threat of an avalanche. A number of factors are combined to determine the AHI of a road, factors including snowfall abundance, terrain steepness, and traffic volume. As shown in Table 3-1, the AHI rating system characterizes risk in a range from Very Low (numerical value < 1) to Very High (numerical value > 150).

Table 3-1. Hazard Category as Defined by the Avalanche Hazard Index

Hazard Category	Avalanche Hazard Index (AHI)
Very Low	Less than 1
Low	1 to 10
Moderate	10 to 40
High	40 to 150
Very High	Greater than 150

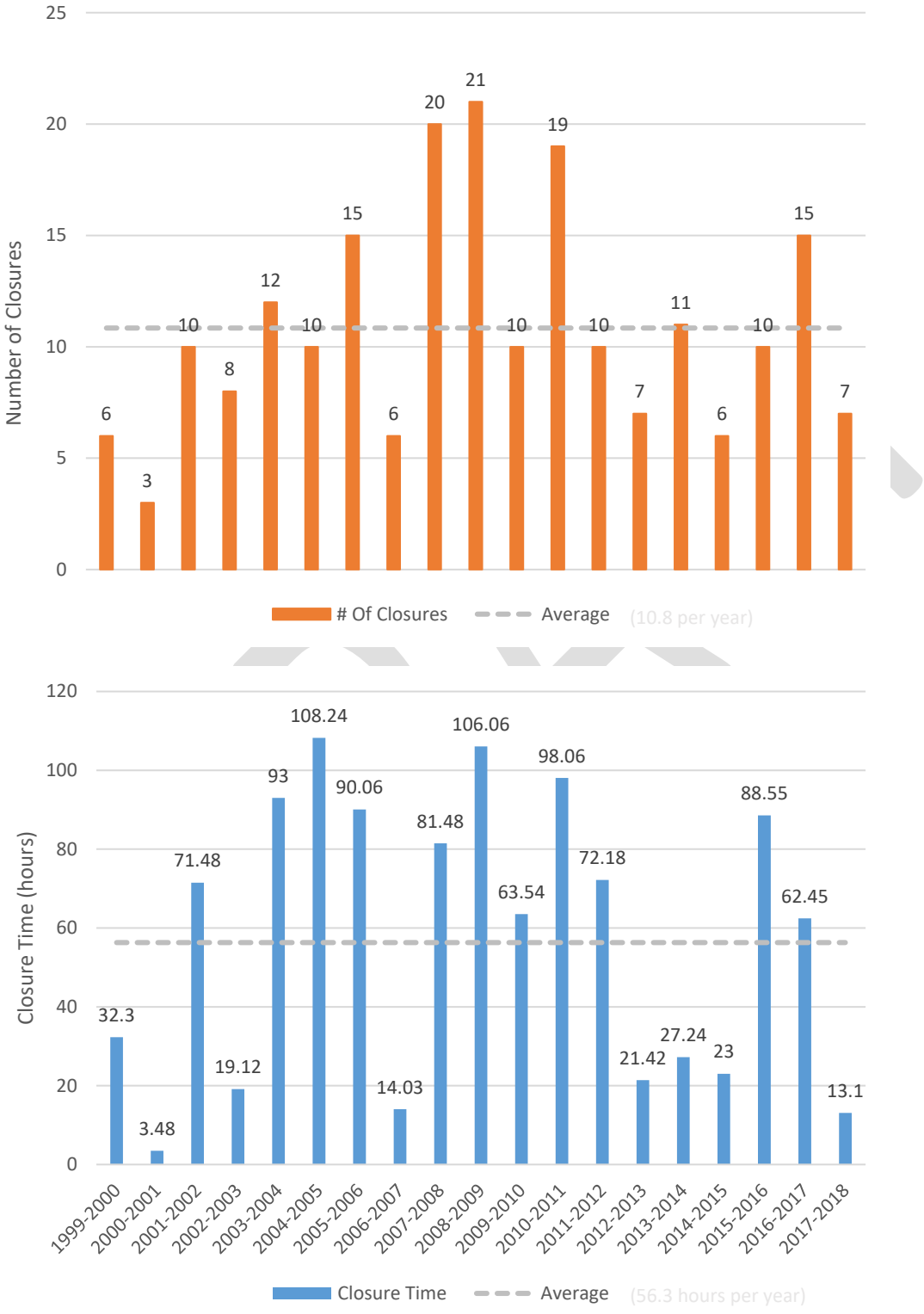
Source: Dynamic Avalanche Consulting 2018a

Little Cottonwood Canyon Road has one of the highest avalanche risks in North America based on AHI calculations without any control program (UDOT 2006). With no avalanche control and using actual traffic volumes for 2018, the AHI for Little Cottonwood Canyon is about 7,300. Using projected traffic volumes for 2050, the AHI increases to about 7,900 because increased vehicle use of S.R. 210 results in a higher risk.

With UDOT's active avalanche-control program in the canyon and the use of the Alta Bypass Road, the AHI is reduced to about 90 in 2018 and would be about 96 in 2050 (Dynamic Avalanche Consulting 2018b). The AHI with active control is still categorized as High; however, the avalanche risk is about 1% of the risk without the active control program.

Based on data recorded by UDOT, from 1999 to 2018, UDOT closed the road in Little Cottonwood Canyon an average of 10.8 days per year for part of the day to conduct avalanche control. During this period, there were an average of 56.3 hours of road closure per year, or about 5 hours of road closure per avalanche-control event (Dynamic Avalanche Consulting 2018b). The greatest number of closures between 1999 and 2018 occurred during the 2008–2009 winter season, which had 21 closure days and a total of 106 hours of closure (Figure 3-2). These closures were mostly due to controlled avalanche releases.

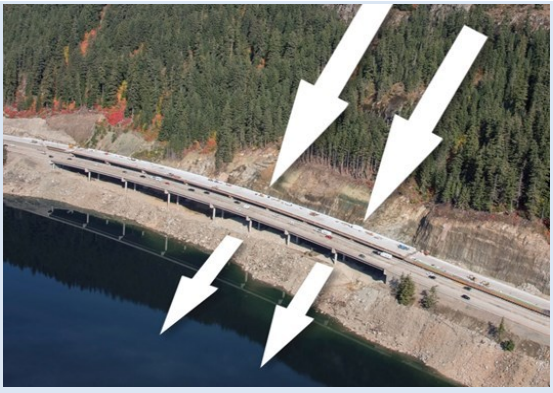
Figure 3-2. Number of Winter Closures and Total Closure Hours for Little Cottonwood Canyon Road (1999–2018)



3.1.1.4 Avalanche Mitigation Preliminary Alternatives

Based on public and agency input and analysis conducted by UDOT, Table 3-2 lists the preliminary alternatives that emerged from the scoping process to be considered in the avalanche mitigation screening process.

Table 3-2. Preliminary Alternatives – Avalanche Mitigation

Avalanche Mitigation Alternative	Description	
Snow-supporting Structures Alternative	Snow-supporting structures are placed in the avalanche starting zone to hold the snow in place and prevent avalanches. Modern snow-supporting structures are now typically constructed using anchored wire nets, with either one single anchor point, or with supporting posts.	
Road Realignment and Bridges Alternative	S.R. 210 would be realigned to facilitate structures that would be built so that the avalanche flows could pass under the roadway to eliminate risk, or S.R. 210 would be realigned to move the road outside the avalanche path.	
Snow Sheds Alternative	Snow sheds are rigid, concrete and/or steel structures that protect a road by diverting avalanches over the top of the structure. Snow sheds mostly prevent avalanche flows from hitting a road, except in cases where they are not sufficiently long and can have the portals (open ends) overtopped.	

(*continued on next page*)

Table 3-2. Preliminary Alternatives – Avalanche Mitigation

Avalanche Mitigation Alternative	Description	
Earth Berms Alternative (Stopping Dams and Diversion Berms)	Earth berms are large, earth-fill structures that are constructed in the runout zone to divert or stop avalanche flows. Berms that stop avalanches are called stopping dams, and berms that divert flow are called diversion berms. Berms are typically constructed of compacted earth, but other materials such as geotextiles and facing units (for example, gabbions, concrete blocks, or stacked rock) can be used to create a steep upslope face and reduce the amount of fill needed. The "China Wall" at the base of the White Pine path is an example of an earth-fill berm with stone facing.	
Stopping Walls Alternative	Stopping walls are constructed to stop avalanche dense flows in the runout zone typically adjacent to a highway or structure that is to be protected. Stopping walls can be reinforced concrete, concrete blocks, snow fence/catcher, and/or driven piles with cross members. Stopping walls are typically constructed where there are space restrictions; otherwise, earth-fill diversions or stopping dams tend to be more economical and can be constructed much higher.	
Reduce Traffic Flow Alternative (Bus/Gondola/Train)	This alternative includes options to reduce the vehicle use of Little Cottonwood Canyon through increased use of transit, gondola, or rail.	

3.1.2 Screening of Alternatives

This section describes the three-step screening process for evaluating alternatives to improve reliability and safety on S.R. 210 through avalanche mitigation. To screen the preliminary avalanche mitigation alternatives, UDOT conducted an initial preliminary evaluation prior to Level 1 and Level 2 screening. The purpose of the preliminary evaluation was to determine whether the preliminary alternatives are feasible for use in Little Cottonwood Canyon give the topographic features, large snow volumes, and avalanche type that occur. Following the preliminary evaluation, Level 1 and Level 2 screening was conducted.

3.1.2.1 Preliminary Alternatives Evaluation

The screening process for avalanche mitigation included a preliminary review of each alternative to determine whether the avalanche mitigation could substantially reduce the hours and days of closure caused by the type of avalanche that typically occurs in Little Cottonwood Canyon. In Little Cottonwood Canyon, the nature of the terrain (typically gullied and/or with smooth ground cover) and often dry snow characteristics result in very fast-moving, turbulent, mixed-flow avalanches, which have a basal dense flow component and a turbulent powder component. Wet flows are also common in the spring. This analysis is based on a review of the avalanche mitigation alternatives conducted by Dynamic Avalanche (Dynamic Avalanche Consulting 2018a, 2018b).

Little Cottonwood Canyon is in the Uinta-Wasatch-Cache National Forest. The canyon is home to two National Wilderness Areas: Twin Peaks Wilderness to the north of S.R. 210 and Lone Peak Wilderness to the south. The Wilderness Act does not allow permanent structures within a wilderness (for more information, see Section 1.4.4, Wilderness Act of 1964). Therefore, as part of the preliminary review of avalanche mitigation alternatives, UDOT eliminated from detailed consideration any alternative that would conflict with the Wilderness Act by requiring construction of a significant structure or fence in a wilderness area as long as there were other reasonable alternatives available that would avoid wilderness areas.

3.1.2.1.1 Snow-Supporting Structures Alternative

With this alternative, snow-supporting structures could be applied in many of the avalanche starting zone areas above Little Cottonwood Canyon. This option, however, would require the structure to be placed in a designated wilderness area, which conflicts with the Wilderness Act. In addition, the alternative would have a substantial visual impact and prevent backcountry skiing in some areas. Given the large number of avalanche starting zones, this alternative would require a substantial land area to be effective and could be used for only a few high-frequency avalanche paths. Because snow-supporting structures would need to be placed in a wilderness area and would reduce recreation activities in the area of the structure, they were not carried forward for Level 1 screening.

3.1.2.1.2 Road Realignment and Bridges Alternative

With this alternative, S.R. 210 would be realigned and bridges would be built so that avalanches would not impact the roadway. This configuration can be achieved by rerouting the roadway (away from the avalanche paths) or, in the right circumstances, spanning the avalanche paths with bridges. Although road realignment and bridges would prevent most avalanches from impacting the road, there would still be powder avalanche risk that would require UDOT to perform active avalanche control which would require some road closure.

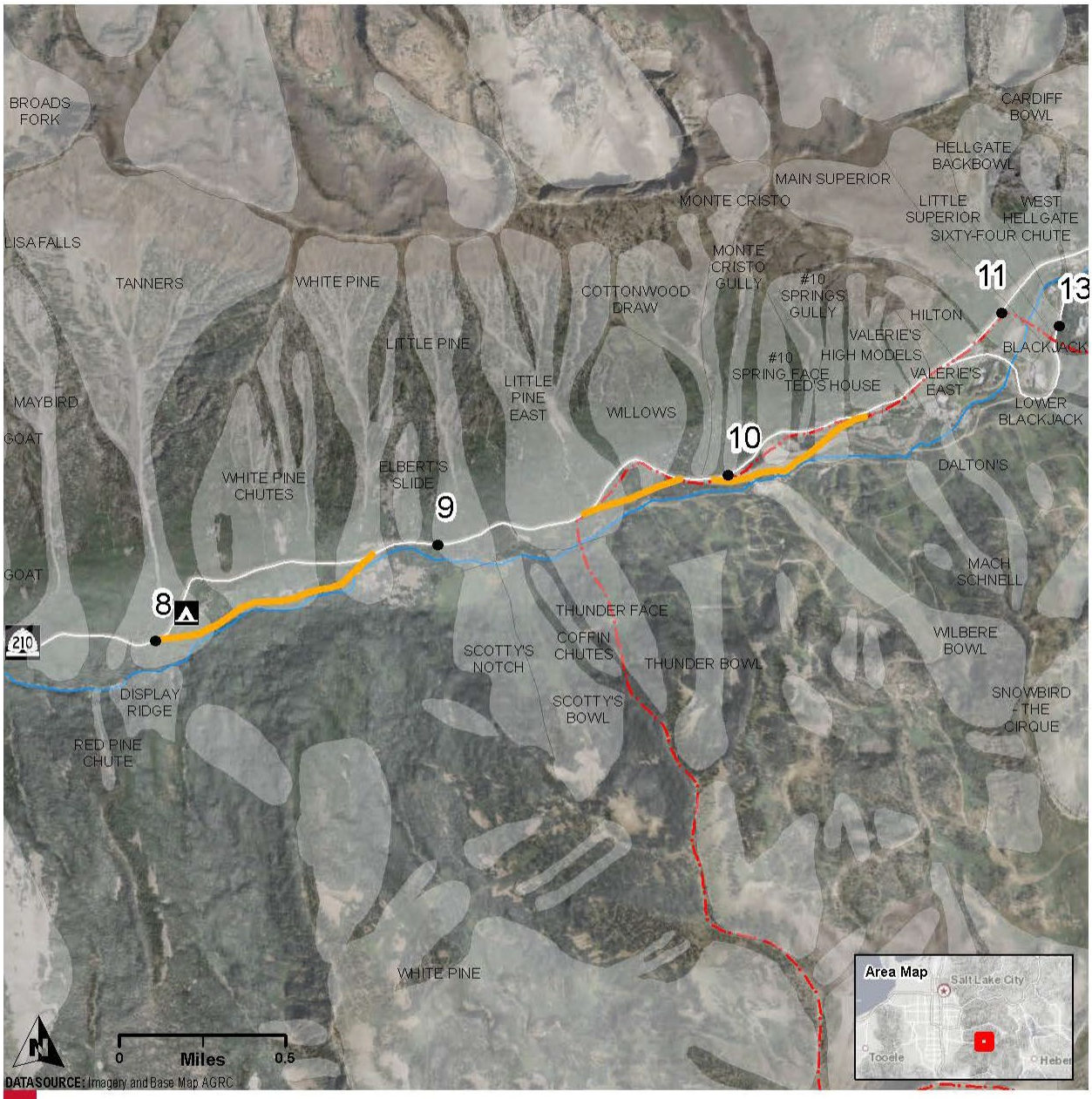
As shown in Figure 3-3, the main issue with road realignment and bridges is that the road would need to be realigned in the Tanner Flats Campground, thereby impacting this Section 4(f) resource and one of the primary campgrounds in Little Cottonwood Canyon. With the realignment, most of the camp sites would be eliminated. Additionally, the road realignment would require straightening the existing road, thereby increasing the grade from about 8% to 9.2%. Because the road realignment option would impact the Tanner Flat Campground, a Section 4(f) resource, and because other alternatives are available (snow shed alternative) that would avoid the campground, this alternative was not carried forward into Level 1 screening.

A second alignment was also suggested that would cross Little Cottonwood Creek south of the Tanners Flat Campground run on the south side of the canyon and cross the creek and reconnection with S.R. 210 before Snowbird Entry 1. This alternative was eliminated because it would cross into the Lone Peak Wilderness. The Wilderness Act states there shall be no commercial enterprise and no permanent road within any wilderness area designated by the Act.

3.1.2.1.3 Snow Sheds Alternative

Based on the preliminary evaluation, snow sheds would result in the greatest reduction in the avalanche hazard and would not impact any wilderness areas. Therefore, this alternative was carried forward into Level 1 screening. The width of the proposed snow sheds would cover the existing travel lanes in Little Cottonwood Canyon.

Figure 3-3. S.R. 210 Realignment for Avalanche Mitigation



3.1.2.1.4 Earth Berms Alternative

Berms need to be constructed high enough to either stop an avalanche flow or divert it. The height is determined by the sum of the height of snow on the ground, the height of previous deposits, the avalanche flow height, and, most importantly, the speed of the avalanche, which determines the run-up height of the avalanche flow on the berm. Avalanche flows would run up higher on a stopping dam where the dam is oriented perpendicular to the flow compared to a diversion berm, where the berm is oriented obliquely to the flow direction.

In Little Cottonwood Canyon, the nature of the terrain (typically gullied and/or with smooth ground cover) and often dry snow characteristics result in very fast-moving, turbulent, mixed-flow avalanches, which have a basal dense flow component and a turbulent powder component. Wet flows are also common in the spring. Because of the fast-moving avalanches, diversion and stopping berms need to be very high to be effective for the dense flow, and would typically be ineffective for stopping or diverting the powder component. Berm walls were not carried forward for Level 1 screening because they would not be effective for very fast-moving avalanches and would be overtopped by powder avalanche flows, which could become airborne below the berm. Diversion berms were not carried forward for Level 1 screening eliminated because the berm would divert avalanche flows to adjacent areas, which could reduce the hazard in one path and increase the risk in others, thereby not changing the overall risk.

3.1.2.1.5 Stopping Walls Alternative

The Little Cottonwood Canyon corridor was reviewed to determine areas where stopping walls would be feasible. No locations were identified where stopping walls would be completely effective. All of the paths reviewed produce fast-moving, turbulent avalanches that would simply overtop these structures, and active avalanche control would still be needed to reduce risk to acceptable levels. Therefore, stopping walls were not carried forward for Level 1 screening.

3.1.2.1.6 Reduce Traffic Flow Alternative

This avalanche mitigation alternative would use some type of mass transit option to reduce the risk of the avalanche hazard. The type of transit could include bus, train, or gondola. All options would require some form of traffic-management strategies to shift travelers onto mass transit instead of personal vehicles. The option would not fully eliminate use of S.R. 210 by vehicles, since delivery trucks and residents would still need access.

A rail or bus option would reduce the likelihood of an avalanche/vehicle encounter by reducing the number of vehicles on the road. Even under high avalanche-hazard conditions, the train or bus could be coordinated with the avalanche forecasters to minimize the probability of encounter (for example, by regulating departures as a function of avalanche control). The challenge with a road-focused option is that avalanche debris would still need to be removed from the tracks or road. Although reducing vehicles to about 1,000 cars per day could reduce the AHI to 37, it would not reduce the days or hours of closure since avalanche-control work would still need to be performed, similar to current conditions. A gondola system would eliminate most of the avalanche hazard since it would travel over the avalanche paths. During avalanche-related road closures, skiers could shift to the gondola. Therefore, a gondola system was carried forward for Level 1 screening.

3.1.2.2 Level 1 Screening

3.1.2.2.1 Level 1 Screening Alternatives

Based on UDOT's evaluation of the preliminary avalanche mitigation alternatives, the following alternatives and measure were eliminated from further consideration:

- Active avalanche-control measures
- Snow-supporting Structures Alternative
- Road Realignment and Bridges Alternative
- Earth Berms Alternative
- Stopping Walls Alternative

The following alternatives were carried forward for Level 1 screening:

- Snow Sheds Alternative
- Reduce Traffic Flow Alternative (Gondola)

3.1.2.2.2 Level 1 Screening Criteria

The alternatives that were evaluated in Level 1 screening for avalanche mitigation were evaluated against the criteria in Table 3-3. The criteria focused on reducing the number of hours and/or days when S.R. 210 is closed because of avalanche mitigation and reducing the avalanche hazard to roadway users.

Table 3-3. Level 1 Screening Criteria – Avalanche Mitigation

Criterion	Measure
Improve avalanche related roadway reliability and safety in 2050	• Substantially reduce number of hours and/or days that avalanches delay users. • Substantially reduce the avalanche hazard for roadway users.

3.1.2.2.3 Level 1 Screening Methodology

For Level 1 screening of the avalanche mitigation alternatives, UDOT hired experts in avalanche analysis and mitigation techniques to conduct the analysis. During the process, two reports were produced:

- *Little Cottonwood Canyon EIS, Snow Avalanche Hazard Baseline Condition Report* (Dynamic Avalanche Consulting 2018a)
- *Little Cottonwood Canyon EIS, Snow Avalanche Hazard Improvement Options Report* (Dynamic Avalanche Consulting 2018b)

The methods used to conduct the analysis included the following:

- Re-map avalanche paths affecting the road using high-resolution topography and images.
- Review avalanche occurrence data and historical information (written and verbal from avalanche forecasters) for avalanche history.
- Analyze avalanche magnitude and frequency.
- Conduct a field validation trip to Little Cottonwood Canyon to assess remapped avalanche paths.
- Conduct sensitivity analysis of the AHI for the current conditions that reflect a range of traffic conditions during the winter.
- Re-evaluate AHI based on the alternatives, including sensitivity analyses.
- Prepare a report that evaluates the potential reduction in AHI and reduction in closure times.

3.1.2.2.4 Level 1 Screening Results

As shown in Table 3-4, in 2050, Little Cottonwood Canyon is projected to be closed up to about 21 days and 108 hours per winter season for avalanche-mitigation work. The increase in closures is based on the greater risk with higher traffic volumes in 2050 compared to 2017. The AHI for Little Cottonwood Canyon with the current type of active avalanche-mitigation program would be an AHI of 96, or High Risk by 2050.

Table 3-4. Level 1 Screening Results – Avalanche Mitigation

Concept	Traffic (vehicles/ day)	AHI[a]	Average Days of Closures	Average Hours of Closures	Estimated Cost (2018 dollars)
Current avalanche mitigation strategies – 2018 traffic volumes	8,200	90	10.4	56.3	Not applicable
Current avalanche mitigation strategies – 2050 traffic volumes	11,300	96	10.5 to 21	56 to 108+	<$50 million
Snow shed with 2050 traffic volumes	11,300	59	4 to 6	2 to 11	$70–$90 million
Gondola with 2050 traffic volumes[b]	1,000+	37	10.5 to 21	56 to 108+	$312–$343 million

[a] AHI is the avalanche hazard index. <1 = very low; 1 to 10 = low; 10 to 40 = moderate; 40 to 150 = high; > 150 = very high

[b] Assumes vehicle traffic-management strategies implemented to increase use of gondola

As shown above in Table 3-4, both the snow shed and gondola alternatives would substantially reduce the avalanche hazard for roadway users, reducing the AHI in 2050 from 96 to 59 for the snow shed alternative and to 37 for the gondola alternative. The snow shed alternative would reduce the hazard by allowing avalanche flows to go over the road, and the gondola alternative by passing the avalanche flow under the gondola system.

The gondola alternative would require some form of congestion-management strategy to make vehicle users shift to the gondola system. However, even with a toll in place, some users including delivery truck drivers, residents, and skiers who still want to use their personal vehicles, would still use the road. Although the gondola alternative would reduce vehicle use of S.R. 210 (assuming a high user fee for vehicles), there would still need to be a substantial active avalanche-control program, similar to current conditions. Using the same avalanche-mitigation system would result in the same number of days and hours of closure as with the current active avalanche-mitigation strategies and thus would not meet the criterion of substantially reducing the number of hours and/or days when avalanches delay users. However, the gondola system would provide the opportunity for skiers to shift to the gondola when the road is closed. Therefore the gondola alternative was considered a reasonable alternative to building snow sheds. The gondola might not be able to operate during active avalanche control since it would be in the path of artillery fire. The gondola would need to be out of service only during the time artillery is in use and could immediately operate after active avalanche-control operations cease, likely early in the morning.

Although it was not a screening criterion, UDOT considered the use of artillery shells in evaluating avalanche mitigation. From 2004 to 2017, an average of 153 artillery shells per ski season were fired into the avalanche paths considered in the study area. With the gondola alternative, UDOT would still need to conduct avalanche control and artillery use similar to existing conditions. However, with the snow shed

alternative, UDOT anticipates that artillery use could be reduced by 80% to about 31 artillery shells per season (Dynamic Avalanche Consulting 2019).

Because the snow shed alternative would both substantially reduce the number of days and hours of road closure and substantially reduce the avalanche hazard to roadway users, the **Snow Sheds Alternative** was carried forward for Level 2 screening along with the **Reduce Traffic Flow Alternative** (with a gondola system) (for more information about the gondola system, see Section 2.2.2.2.2, Aerial Transit from the Salt Lake Valley Alternative).

3.1.2.3 Level 2 Screening

The Snow Sheds Alternative and the Reduce Traffic Flow Alternative (with a gondola system) were carried forward for Level 2 screening.

For Level 2 screening, UDOT developed three snow shed alternatives (see Appendix J, Draft Snow Shed Concepts) and evaluated them along with Gondola Alternative 3B from the analysis of aerial transit alternatives:

- **Snow Sheds Alternative with No Berms** – two snow sheds with total length of 3,194 feet.
- **Snow Sheds Alternative with Berms** – two snow sheds with total length of 2,465 feet. Berms reduce snow shed length by guiding avalanche flows over smaller sheds. Two berms would be required for each shed, about 20 feet high and 300 feet long.
- **Snow Sheds Alternative with Realigned Road and No Berms** – two snow sheds with a total length of 3,194 feet. UDOT would realign the road to place snow sheds closer to the mountain to reduce cost of material needed to fill the gap between the mountain and snow sheds. The alternative also lessens curves to improve safety in the tunnels without substantially increasing the road grade.
- **Gondola Alternative 3B** – See Section 2.2.2.2.2, Aerial Transit from the Salt Lake Valley Alternative, for Level 2 screening information for the gondola alternative.

UDOT developed a preliminary engineering design for each alternative to determine the expected impacts for each Level 2 criterion [see Table 1-2, Level 2 Screening Criteria (Impacts), above]. Table 3-5 shows the results of Level 2 screening. For information about the Level 2 screening of the gondola alternative, see Section 2.2.2.2.2, Aerial Transit from the Salt Lake Valley Alternative.

Table 3-5. Level 2 Screening Results – Avalanche Mitigation

Impact Criterion	Unit	Alternative		
		Snow Sheds with No Berms	Snow Sheds with Berms	Snow Sheds with Realigned Road and No Berms
Natural Environment[a]				
Wetlands	Acres	0.00	0.00	0.00
Streams	Acres	0.01	0.01	0.01
Critical habitat	Acres	0.00	0.00	0.00
Floodplains	Acres	0.01	0.14	0.03
Impacts to wilderness areas	Acres	0.00	0.00	0.00
Built Environment[a]				
Consistency with USDA Forest Service Plan	Yes/no	Yes	Yes	Yes
Consistency with local plans	Yes/no	Not applicable	Not applicable	Not applicable
Recreation sites	Number	0	0	0
Community facilities	Number	0	0	0
Residential relocations	Number	0	0	0
Business relocations	Number	0	0	0
Section 4(f) properties	Number	1	1	1
Historic properties	Number	1	1	1
Cost of alternative in 2020 (in 2020 dollars)	Dollars	$89 million	$72 million	$86 million

[a] The acreage or number of impacts is based on a screening-level design. The actual impacts could decrease or increase based on more-detailed design conducted for the alternatives that pass Level 2 screening.

3.1.2.3.1 Level 2 Screening Results

As shown above in Table 3-5, the results are similar among the snow shed alternatives evaluated in Level 2 screening, with the main differences being the amount of floodplains impacted and cost. Reviewing the impact and cost information, UDOT decided to carry forward the Snow Shed with Berms Alternative because it had the least cost by $14 million as a result of the reduced snow shed length. Although the Snow Shed with Berm Alternatives would have high visual impacts, it would contribute to a reasonable range of alternatives to evaluate in further detail in the EIS.

Comparing the impacts and cost of the two snow shed alternatives without berms (Snow Sheds Alternative with No Berms and Snow Sheds Alternative with Realigned Road and No Berms) shows that the impacts would be similar, with the only difference about 0.02 acre of floodplain impact. However, between the two alternatives, the alternative with the realigned road would lessen curves in the snow sheds, which would improve driver safety, move the road slightly farther from Little Cottonwood Creek, and cost about $3 million less; therefore, UDOT selected the Snow Sheds Alternative with Realigned Road and No Berms to be evaluated further in the EIS.

Based on the Level 2 screening process for snow sheds, UDOT decided to carry forward the **Snow Sheds Alternative with Berms** and the **Snow Sheds Alternative with Realigned Road and No Berms** for detailed evaluation in the EIS. The Snow Sheds Alternative with No Berms was eliminated from further consideration. **Gondola Alternative 3B** is being carried forward for detailed evaluation in the EIS as an alternative for improving mobility on S.R. 210 from Fort Union Boulevard to Alta as well as an alternative to address avalanche mitigation.

3.1.2.3.2 Alternatives Carried Forward for Further Evaluation

The following avalanche mitigation alternatives will be carried forward for further evaluation in the EIS:

- Snow Sheds Alternative with Berms
- Snow Sheds Alternative with Realigned Road and No Berms
- Gondola Alternative 3B

3.2 Improve Reliability and Safety through Improving Trailhead Parking

Trailhead parking areas in Little Cottonwood Canyon are small and can quickly reach capacity in the summer, forcing many people to park on the side of the road and walk along or across the roadway to access trailheads, which creates a safety risk. One of the most congested parking areas is the White Pine Trailhead, located at a curve with limited sight distances and narrow shoulders, which increase safety-related risk for motorists, bicyclists, and pedestrians. Roadside parking also creates a safety hazard for cyclists and pedestrians traveling along the roadway shoulder because it narrows the area in which they can travel and requires them in some locations to use part of the travel lane to pass park vehicles. Therefore, to meet the criteria of improving safety and reducing traffic conflicts, the roadside parking would need to be eliminated as part of any alternative.

Eliminating roadside parking would improve safety by removing the need for trail users parked along S.R. 210 to walk along or cross the road in areas with limited sight distance and potentially getting struck by road traffic. Eliminating roadside parking would also remove the conflict of cyclists being forced around shoulder-parked vehicles and into the road travel lanes. Other benefits of removing roadside parking include eliminating a rut at the edge of the pavement and removing a network of “spider web” trails that promote erosion and weed infestation. Erosion caused by roadside parking can reduce water quality in Little Cottonwood Creek. Additionally, the improved parking would include enough restroom capacity to handle the number of parking spaces being proposed with each alternative. Restroom facilities would help improve water quality.

3.2.1 Range of Alternatives

UDOT developed a list of preliminary alternatives for improving reliability and safety on S.R. 210 by improving trailhead parking. UDOT gathered these alternatives from public and agency input and the following studies:

- *Cottonwood Canyons Parking Study – Existing Conditions* (Avenue Consultants 2012a)
- *Cottonwood Canyons Parking Study – Recommendations* (Avenue Consultants 2012b)

The USDA Forest Service manages in-canyon parking in Little Cottonwood Canyon per the *Revised Forest Plan Wasatch-Cache National Forest* (USDA Forest Service 2003). For the purpose of watershed protection, the plan indicates that a desired future condition in the Tri-Canyon Area (Big Cottonwood, Little Cottonwood, and Mill Creek Canyons) is to maintain the parking capacities of canyon parking areas (ski area lots, summer-use homes, and developed and dispersed recreation sites) so that parking capacity does not exceed that in year 2000 unless modification is needed for watershed protection or to facilitate mass transit. The USDA Forest Service has been using the 2012 *Cottonwood Canyons Parking Study – Existing Conditions* as the baseline for the 2000 levels since no counts were taken at that time. None of the alternatives developed by UDOT for this analysis would increase parking levels in Little Cottonwood Canyon beyond those estimated in the *Cottonwood Canyons Parking Study – Existing Conditions*. The study included both formal and informal (shoulder) parking in the capacity analysis.

3.2.1.1 Alternatives from Previous Studies

As part of a Cottonwood Canyons Parking Study, a steering committee was assembled from representatives of key stakeholder agencies including Salt Lake County, UDOT, UTA, the USDA Forest Service, Salt Lake City Watershed Planning and Restoration, and WFRC. Additionally, the City of Cottonwood Heights, Sandy City, the resorts, canyon user groups, law enforcement, and other interested parties were consulted outside of steering committee meetings regarding areas within their spheres of influence (Avenue Consultants 2012b).

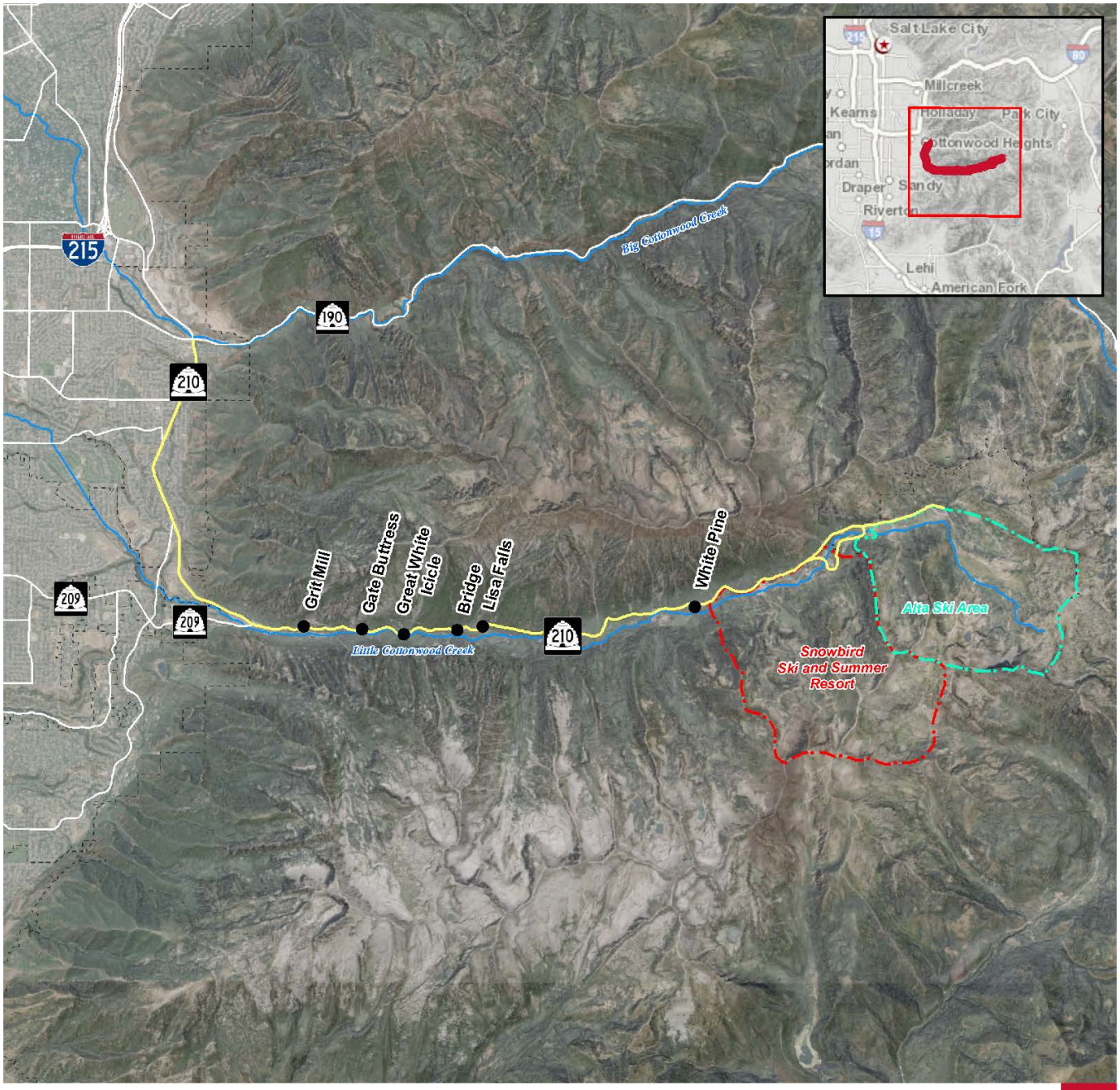
The primary purpose of the study was to identify parking needs for Big and Little Cottonwood Canyons and to develop recommendations that address those needs. The parking improvement goals of the study were safety, capacity, environmental protection, notification and wayfinding, transit support, and maintenance and enforcement. Some of the primary guiding principles included preserve the watershed, incorporate transit opportunities, enhance bicycle safety, preserve the recreational experience by limiting capacity in some areas, and ensuring no net increase in the total number of parking spaces in the canyons. To determine trailhead parking capacities, the study grouped parking within a suitable walking distance of ¼ mile of the parking at trailheads (Avenue Consultants 2012a).

The steering committee narrowed 35 candidate improvement areas down to 17 recommended locations or focus areas in both Big and Little Cottonwood Canyons. These locations included highly used locations inside the canyons, highly used locations at the entrances of the canyons, locations with opportunities for future transit or carpool expansion, and locations identified in previous studies. The focus areas in Little Cottonwood Canyon were the following (Figure 3-4):

- Grit Mill Trailhead
- Lisa Falls Trailhead
- White Pine Trailhead

The USDA Forest Service has completed the planning and environmental process for the Grit Mill parking improvements. An Environmental Assessment for the Grit Mill and Climbing Master Plan Project has been prepared (USDA Forest Service 2014), design for the parking area has been completed, and partial funding has been allocated. Once complete funding is allocated, the project will be constructed; therefore, this alternative will not be evaluated further in the Little Cottonwood Canyon EIS as an alternative.

Figure 3-4. Potential Parking Area Locations



3.2.1.2 Alternatives Suggested during Scoping

3.2.1.2.1 UDOT and USDA Forest Service Evaluation

In addition to the Lisa Falls and White Pine parking areas, UDOT worked with the USDA Forest Service to determine other potential parking locations in Little Cottonwood Canyon. UDOT's review of aerial images taken on a Saturday (June 17, 2017) showed about 10 cars parked on the shoulder of S.R. 210 in the vicinity of Lisa Falls Trailhead (about 0.3 mile down canyon from Lisa Falls) at a connecting trailhead (Bridge Trailhead) that connects to the Little Cottonwood Canyon Trail and can be used to access Lisa Falls Trailhead. Therefore, UDOT and the USDA Forest Service agreed to include the Bridge Trailhead as an alternative for trailhead parking.

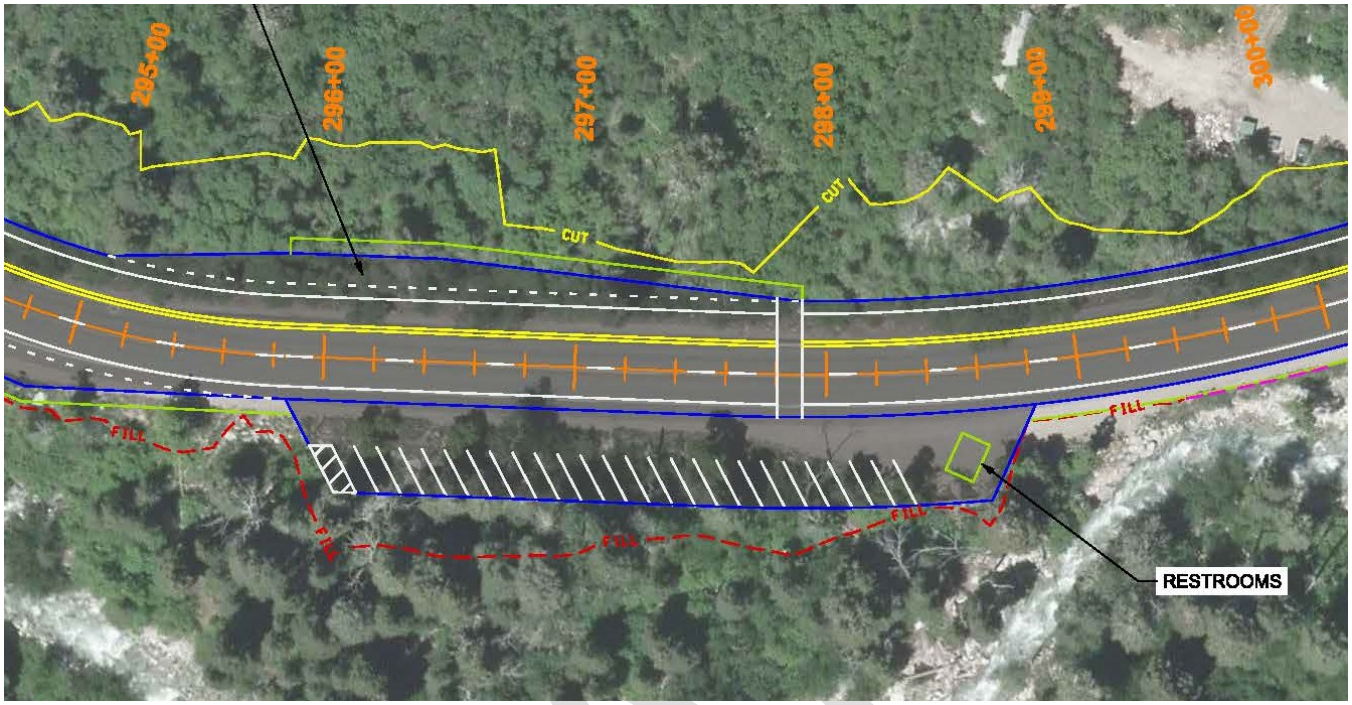
UDOT looked at existing dirt pullouts along S.R. 210 in Little Cottonwood Canyon. However, in working with the USDA Forest Service, UDOT decided not to consider the small pullouts for improvement because most do not include an area to provide parking along with restroom and water qualify best management practices or a designated trailhead with access to the forest. Plus, informal dirt pullout parking areas would not allow the USDA Forest Service to manage the use of the areas adjacent to the parking area for watershed protection.

3.2.1.2.2 Gate Buttress and Great White Icicle

During the 2019 EIS scoping period, the Salt Lake Climbers Alliance requested that Gate Buttress be considered as a parking area. The Gate Buttress is used by climbers to access boulders and climbing areas in lower Little Cottonwood Canyon. Currently there is an existing off-road dirt parking area on the north side of S.R. 210 with a capacity of about 30 vehicles. The property at the parking area is owned by the Church of Jesus Christ of Latter-day Saints and is used under an agreement with the Salt Lake Climbers Alliance. Because this is an existing informal parking area with trails connecting to climbing areas, UDOT decided to include the Gate Buttress as an alternative for trailhead parking.

Parking was also investigated for a climbing area called the Great White Icicle (Figure 3-5), which is a winter climbing area on the south side of Little Cottonwood Canyon. To minimize pedestrians crossing the road on a corner, the proposed concept was designed on the south side of S.R. 210. In this area, Little Cottonwood Creek is immediately adjacent to S.R. 210. One concern with the concept is that it could promote crossing the creek on a water pipeline on private land marked No Trespassing. Because the parking area would be within 20 feet of Little Cottonwood Creek and because the riparian corridor could be damaged during construction, this parking concept was not carried forward for Level 1 screening. Access to the Great White Icicle climbing area can be provided by the proposed Bridge Trailhead ½ mile up canyon where there is an existing bridge that crosses Little Cottonwood Creek and an existing trail on the south side of the creek that can provide access to the climbing area.

Figure 3-5. Great White Icicle Trailhead Parking Concept



3.2.1.2.3 Elimination of Roadside Parking, No Trailhead Expansion, and Summer Transit

In a meeting with Save Our Canyons on January 16, 2019, an alternative was suggested to UDOT: do not increase parking lot sizes and instead provide transit stops at the trailheads (UDOT Alternative C). If this were considered along with eliminating roadside parking, it would reduce the ability of recreational users to use personal vehicles to access trailheads beyond the existing parking lots. Based on input from Save Our Canyons, UDOT decided to evaluate an alternative that would eliminate roadside parking on S.R. 210 from S.R. 209 to Snowbird Entry 1 and would not include expansion of existing parking areas. The elimination of roadside parking from S.R. 209 to Snowbird Entry 1 and no parking expansion is different from the No-Action Alternative in that it eliminates roadside parking in Little Cottonwood Canyon in areas associated with trailhead parking.

The assumption with the alternative suggested by Save Our Canyons and other scoping comments is that UTA or a private vendor would provide supporting summer transit service to allow recreation users to access the trailheads. Currently, neither UTA nor private vendors provide summer transit services. The purpose of improving trailhead parking is to remove roadside parking conflicts between cyclists and pedestrians and vehicles parking on the road shoulder and partially in the travel lane, not to increase use at trailheads by providing summer transit service. Summer mobility was not identified as a project need; therefore, summer transit service that could improve mobility was not carried forward for Level 1 screening. Implementation of summer transit is an operational issue and can be implemented independently of the Little Cottonwood Canyon EIS process. In addition, this alternative does not preclude UTA or a private vendor from implementing a summer transit service with approval from the USDA Forest Service.

3.2.1.3 Trailhead Parking Preliminary Alternatives

Based on the *Cottonwood Canyons Parking Study – Recommendations* study and in working with the USDA Forest Service and other stakeholder input, UDOT developed the preliminary alternatives listed in Table 3-6 (see Figure 3-6 through Figure 3-9 for UDOT options). To determine the size to improve parking areas, UDOT determined the number of roadside parking spaces within ¼ mile on either side of the existing parking area that would be eliminated. A ¼-mile distance was used in the 2012 Avenue Consultants study to determine parking area capacities, and the study noted that ¼ mile was a suitable walking distance to trailhead locations (Avenue Consultants 2012a). Another study found that ¼ mile is a reasonable walking distance for parents to take children to a park location (Wolch and others 2005). Additionally, of the trailheads evaluated, the greatest roadside parking distance from the trailhead for vehicles parked on the road was observed at the White Pine Trailhead, where during peak periods vehicles were observed parking on the roadside out to about ¼ mile on either side of the trailhead.

UDOT considered one parking lot improvement alternative (Alternative A) each for the Gate Buttress and Bridge Trailheads and two alternatives (Alternatives A and B) for the Lisa Falls and White Pine Trailheads. With the improved parking lot alternatives (Alternatives A and B), UDOT considered two alternatives for roadside parking: one that would eliminate roadside parking within ¼ mile of each trailhead parking area and one that would eliminate all roadside parking from the intersection of S.R. 209/S.R. 210 to Snowbird Entry 1. Alternative C includes eliminating roadside trailhead parking related to summer use from the intersection of S.R. 209/S.R. 210 to Snowbird Entry 1 and no expansion of existing parking areas.

Table 3-6. Preliminary Alternatives – Trailhead Parking

Location	Canyon Parking Study Alternatives[a]	Alternatives A[b]	Alternatives B[b]	Alternative C
Gate Buttress	None	Proposed – 21 spaces Includes eliminating roadside parking within ¼ mile on either side of road from trailhead.	None	No parking area expansion at any trailhead, and eliminate roadside parking from the intersection of S.R. 209/S.R. 210 to Snowbird Entry 1.
Bridge Trailhead	None	Proposed – 15 spaces Includes eliminating roadside parking within ¼ mile on either side of road from trailhead. Create parking area on south side of road and include restrooms.	None	
Lisa Falls Trailhead	Proposed – 65 spaces Expand existing parking lot (20 spaces), expand Cottonwood south pullout (20 spaces), and improve shoulder parking (25 spaces).	Proposed – 41 spaces Includes eliminating roadside parking within ¼ mile on either side of road from trailhead. Expand existing parking lot and include restrooms. The number of parking spaces had to be reduced by 5 from existing conditions because the topography limits the number of parking spaces.	Proposed – 46 spaces Includes eliminating roadside parking within ¼ mile on either side of road from trailhead. Expand existing parking lot to the North of S.R. 210, realign the road on a bridge, and include restrooms.	
White Pine Trailhead	Proposed – 125 spaces Expand existing parking lot (80 spaces) and improve shoulder parking (45 spaces).	Proposed – 144 spaces Includes eliminating roadside parking within ¼ mile on either side of road from trailhead. Expand existing parking lot and provide restrooms.	Proposed – 141 spaces Includes eliminating roadside parking within ¼ mile on either side of road from trailhead. This alternative would reduce the size of the main parking by providing 25 angled parking spaces on S.R. 210. Restrooms are included in the design.	

[a] No design figures were provided as part of the Canyon Parking Study.

[b] Both options can support elimination of roadside parking within ¼ mile of the trailhead and from the intersection of S.R. 209/S.R. 210 to the entrance to Snowbird Entry 1.

Table 3-7 shows the proposed total number of parking spaces proposed with each alternative.

Table 3-7. Total Parking Spaces from S.R. 209/S.R. 210 to Snowbird Entry 1

Parking Area	Number of Parking Spaces[a]						
	Existing Parking	Canyon Parking Study Alternatives	Alternatives A		Alternatives B		Alternative C
			No Roadside Parking ¼ Mile from Trailhead	No Roadside Parking to Snowbird Entry 1	No Roadside Parking ¼ Mile from Trailhead	No Roadside Parking to Snowbird Entry 1	
Roadside parking	429	308	290	0	290	0	0
Gate Buttress	30 (in formal dirt lot)	30 (in formal dirt lot)	21	21 [b]	21	21 [b]	30 (in formal dirt lot)
Bridge Trailhead	N/A (roadside parking only)	N/A (roadside parking only)	15	15[b]	15	15 [b]	0
Lisa Falls Trailhead	17 (north and south dirt pullouts)	65	41	41	46	46	17 (north and south dirt pullouts)
White Pine Trailhead	52	125	144	144	141	141	52
Total parking spaces[a]	**528**	**528**	**511**	**221**	**513**	**223**	**99**

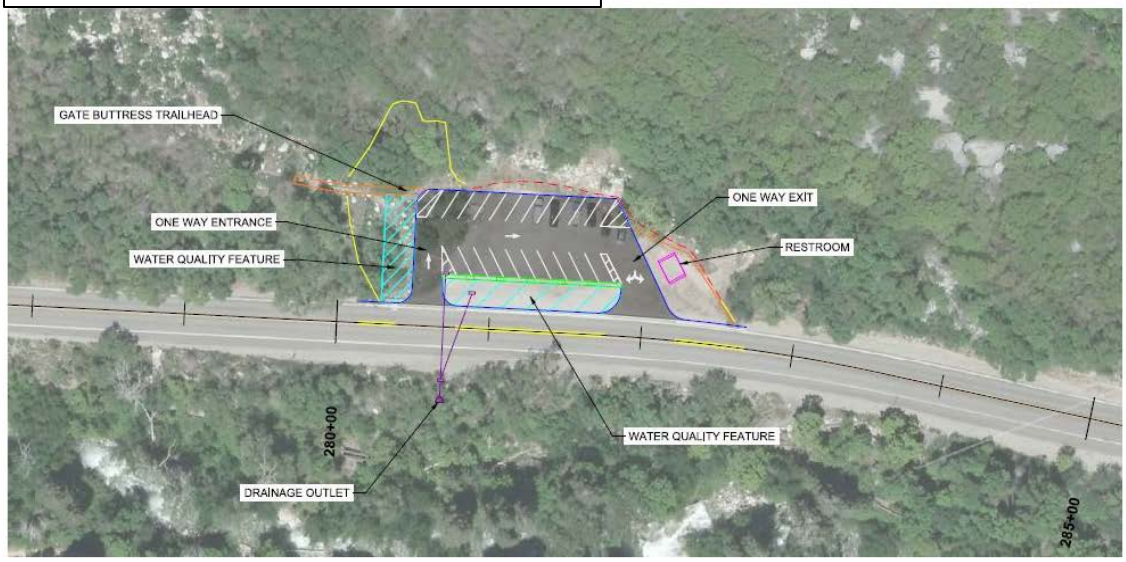
[a] The total number of parking spaces did not capture all of the smaller available pullouts along S.R. 210, so the total number of existing parking would be higher. The proposed Grit Mill parking area is expected to be built in 2020 and was not included as part of the analysis.

[b] There is no Option B for this trailhead. The analysis assumes that the Option A design is included in the parking space numbers.

Some of the alternatives listed above in Table 3-7 would require the use of USDA Forest Service–managed land. UDOT does not currently have a perfected easement for the entire length of S.R. 210 on those lands. If proposed improvements would occur on NFS)-managed land not already appropriated by FHWA, this action would be subject to the conditions of 23 USC Section 317, *Appropriation for Highway Purposes of Lands or Interests in Lands Owned by the United States*. Through this appropriation process, the U.S. Secretary of Agriculture can certify that the appropriation of NFS-managed land for transportation use is contrary to the public interest or inconsistent with the purposes for which the NFS-managed land was originally reserved, or agree to the appropriation and transfer of the land to FHWA and UDOT, potentially with stipulated conditions to protect NFS-managed land. In addition, any project actions proposed on NFS-managed land that would not otherwise be appropriated by FHWA might require a decision by the USDA Forest Service.

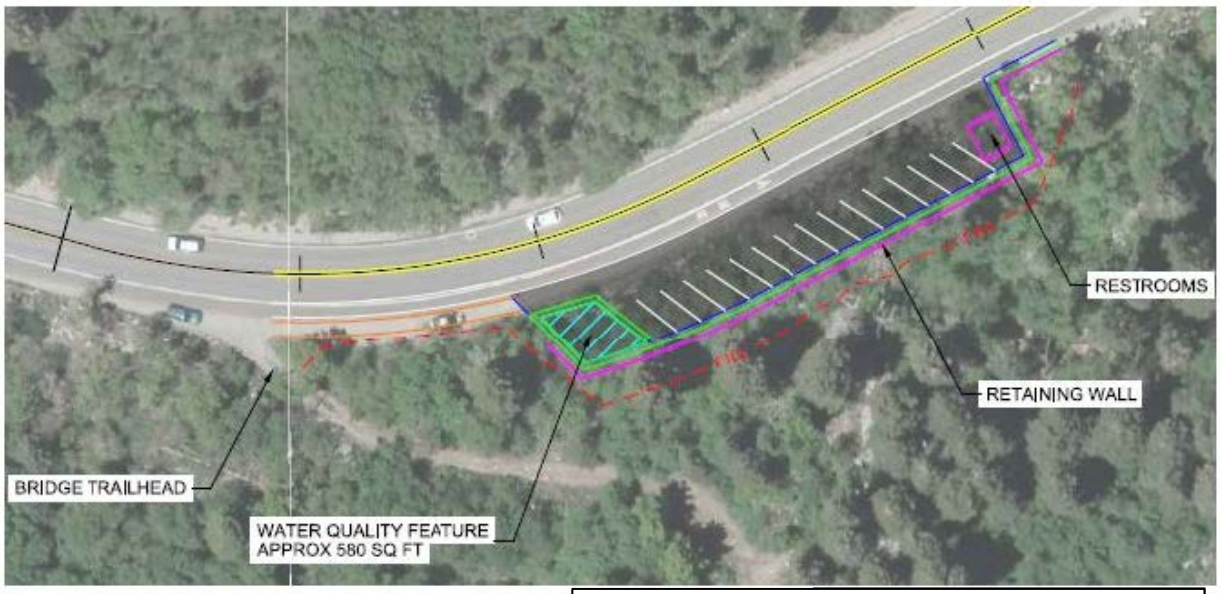
Figure 3-6. Gate Buttress Trailhead Alternative A

Gate Buttress Alternative A – 21 parking spaces



DATA SOURCE: Imagery and Base Map: AGRC

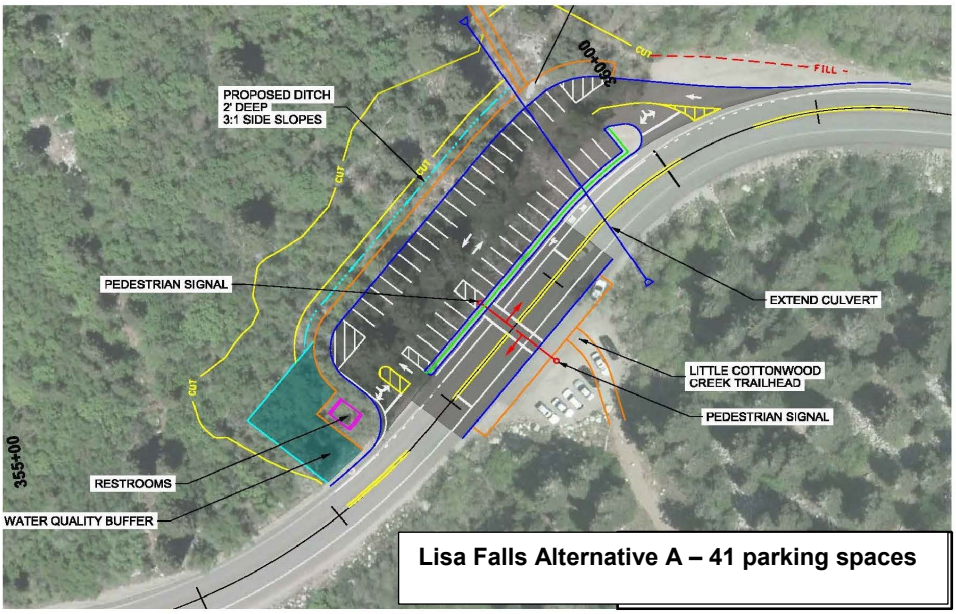
Figure 3-7. Bridge Trailhead Alternative A

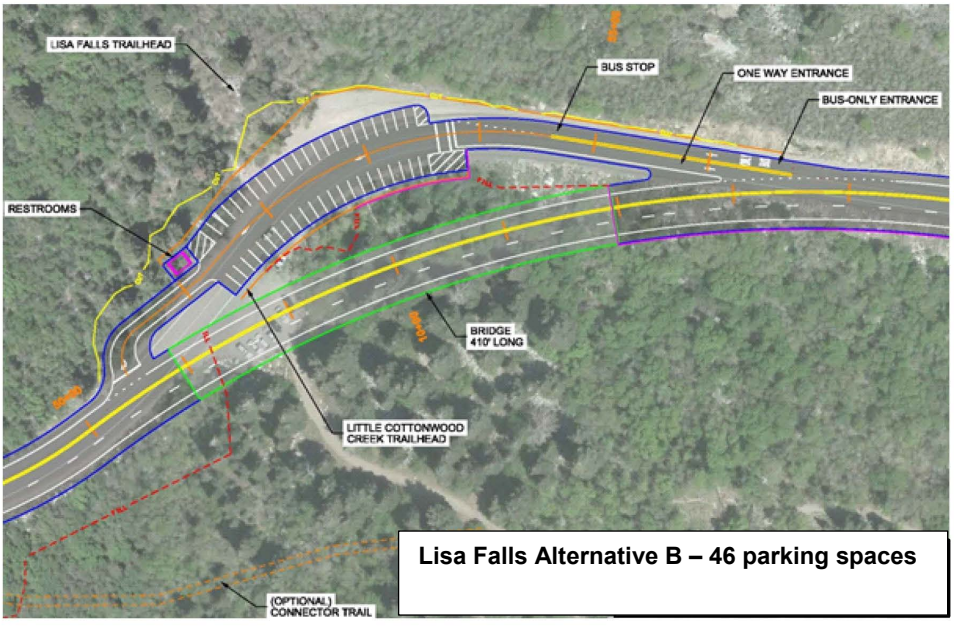


Bridge Trailhead Alternative A – 15 parking spaces

DATA SOURCE: Imagery and Base Map: AGRC

Figure 3-8. Lisa Falls Trailhead Alternatives A and B





DATA SOURCE: Imagery and Base Map: AGRC

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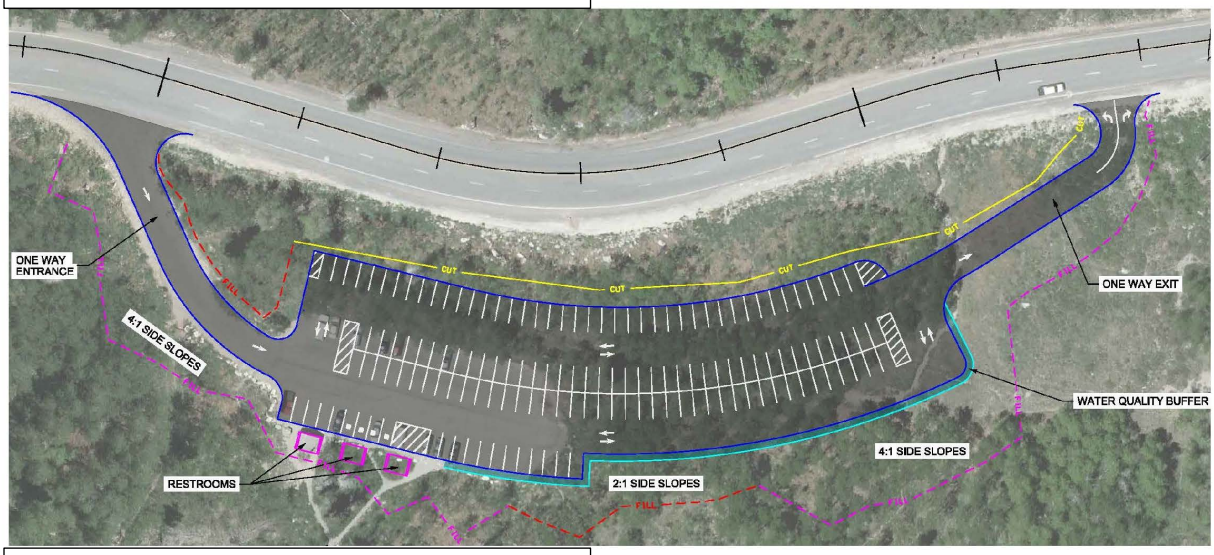
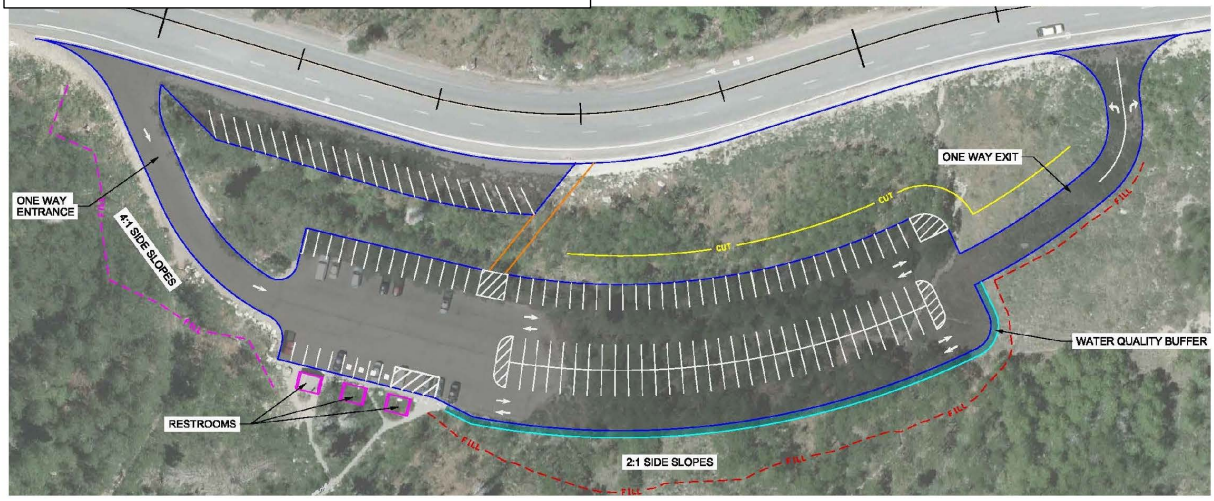
Figure 3-9. White Pine Trailhead Alternatives A and B

White Pine Alternative A – 144 parking spaces



White Pine Alternative B – 141 parking spaces



DATA SOURCE: Imagery and Base Map: AGRC

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3.2.2 Screening of Alternatives

3.2.2.1 Level 1 Screening

3.2.2.1.1 Level 1 Screening Criteria

The four alternatives that were evaluated in Level 1 screening for improving trailhead parking were screened against the criterion in Table 3-8. The criterion focuses on reducing conflicts at existing trailheads, improving safety, and maintaining or reducing existing parking levels.

Table 3-8. Level 1 Screening Criteria – Trailhead Parking

Criterion	Measure
Improve reliability and safety in 2050	• Improve safety at existing trailhead locations. • Reduce or eliminate traffic conflicts between motorized and nonmotorized transportation modes at existing trailhead locations. • Reduce or eliminate roadside parking to improve the safety and operational characteristics of S.R. 210.

3.2.2.1.2 Level 1 Screening Results

Table 3-9 shows the results of Level 1 screening for the trailhead parking alternatives. As shown in the table, all of the Alternative A trailhead alternatives, White Pine Alternative B, and Alternative C (no parking improvements and eliminate roadside parking) passed Level 1 screening. Red-shaded cells in the table are those alternatives that did not pass the Level 1 screening criteria. The A and B Alternatives that passed screening could include eliminating roadside parking within ¼ mile of the improved trailhead parking or eliminating all roadside parking from the S.R. 209/S.R. 210 intersection to Snowbird Entry 1 along with the improved trailhead parking.

Table 3-9. Level 1 Screening Results – Trailhead Parking

Alternative	Level 1 Screening Criteria			Recommended for Further Analysis in Level 2 Screening?	Notes
	Improve Safety	Reduce Traffic Conflicts	Reduce or Eliminate Roadside Parking to Improve Safety and Operations		
No-Action Alternative	No	No	No	No	
Canyon Parking Study Alternatives					
Gate Buttress	**Not applicable**	**Not applicable**	**Not applicable**	**Not applicable**	Not included in Canyon Parking Study
Bridge Trailhead	**Not applicable**	**Not applicable**	**Not applicable**	**Not applicable**	Not included in Canyon Parking Study
Lisa Falls Trailhead	No	No	**Yes**	No	Alternative includes shoulder parking thus would not substantial reduce conflicts or improve safety for pedestrian and bicyclist. Parking spaces increase existing levels.
White Pine Trailhead	No	No	**Yes**	No	Alternative includes shoulder parking thus would not substantial reduce conflicts or improve safety for pedestrian and bicyclist. Parking spaces increase existing levels.
Alternative A					
Gate Buttress	**Yes**	**Yes**	**Yes**	**Yes**	
Bridge Trailhead	**Yes**	**Yes**	**Yes**	**Yes**	
Lisa Falls Trailhead	**Yes**	**Yes**	**Yes**	**Yes**	
White Pine Trailhead	**Yes**	**Yes**	**Yes**	**Yes**	
Alternative B					
Lisa Falls Trailhead	**Yes**	**Yes**	**Yes**	**No**	The concept was eliminated because it would require a 475-foot bridge structure that would increase cost by about $15 million over Alternative A. In addition, the concept would require greater environmental impacts along S.R. 210 with the realigned road.
White Pine Trailhead	**Yes**	**Yes**	**Yes**	**Yes**	
Alternative C					
Gate Buttress, Bridge, Lisa Falls, and White Pine Trailheads	**Yes**	**Yes**	**Yes**	**Yes**	

[a] Alternatives A and B include eliminating roadside parking within ¼ mile of each trailhead and eliminating roadside parking from S.R. 209/S.R. 210 to Snowbird Entry 1.

3.2.2.2 Level 2 Screening

As a result of Level 1 screening, UDOT determined that all of the Alternative A trailhead alternatives, White Pine Alternative B, and Alternative C (no parking improvements and eliminate roadside parking) would meet the purpose of the project and therefore were carried forward for Level 2 screening.

UDOT determined a preliminary engineering design for each alternative to determine the expected impacts for each Level 2 criterion [see Table 1-2, Level 2 Screening Criteria (Impacts), above]. Table 3-10 shows the results of Level 2 screening.

Table 3-10. Level 2 Screening Results – Trailhead Parking

Impact Criterion	Unit	Alternative					
		Gate Buttress A	Bridge Trailhead A	Lisa Falls A	White Pine A	White Pine B	C – No Parking Improve-ments
Natural Environment[a]							
Wetlands	Acres	0	0	0	0	0	0
Streams	Acres	0	0	0.04	0.03	0.03	0
Critical habitat	Acres	0	0	0	0	0	0
Floodplains	Acres	0	0	0	0	0	0
Impacts to wilderness areas	Acres	0	0	0	0	0	0
Built Environment[a]							
Consistency with USDA Forest Service Plan	Yes/no	Yes	Yes	Yes	Yes	Yes	Yes
Consistency with local plans	Yes/no	NA	NA	NA	NA	NA	NA
Recreation sites	Number	0	0	0	0	0	0
Community facilities	Number	0	0	0	0	0	0
Residential relocations	Number	0	0	0	0	0	0
Business relocations	Number	0	0	0	0	0	0
Section 4(f) properties	Number	0	0	0	1	1	0
Historic properties	Number	0	0	0	0	0	0
Cost of alternative in 2019 (in 2019 dollars)	Dollars (millions)	$0.83	$1.4	$2.3	$2.2	$2.9	$0

[a] The acreage or number of impacts is based on a screening-level design. The actual impacts could decrease or increase based on more-detailed design conducted for the alternatives that pass Level 2 screening.

3.2.2.2.1 Level 2 Screening Results

For the trailhead improvement alternatives, only the White Pine trailhead had two alternatives that passed Level 1 screening: Alternatives A and B. Based on the evaluation, both White Pine Alternative A and Alternative B would have similar impacts and cost. However, UDOT decided to eliminate Alternative B because of its slightly higher cost ($700,000 more) and because it would have about 25 parking spaces on S.R. 210 which would require parked vehicles to back onto S.R. 210 causing a potential safety conflict due to cyclists and vehicles traveling in the eastbound travel lane. Alternative C (no parking improvements and eliminate roadside parking) would have no cost or impacts associated with the alternative and therefore passed Level 2 screening.

All of the **Alternative A** trailhead alternatives and **Alternative C** (no parking improvements and eliminate roadside parking) passed Level 2 screening and will be further evaluated in detail in the Draft EIS. The trailhead parking A alternatives have two options: eliminating roadside parking within ¼ mile of the improved trailhead parking and eliminating all roadside parking from S.R. 209/S.R. 210 intersection to Snowbird Entry 1 along with the improved trailhead parking.

3.2.2.2.2 Alternatives Carried Forward for Further Evaluation

The following trailhead alternatives will be carried forward for further evaluation in the EIS:

- **Alternative A Trailhead Parking Improvements with No Roadside Parking within ¼ Mile**
- **Alternative A Trailhead Parking Improvements with No Roadside Parking from Canyon Entrance to Snowbird Entry 1**
- **Alternative C No Trailhead Parking Improvements with No Roadside Parking from Canyon Entrance to Snowbird**

3.3 Improve Reliability and Safety through Eliminating Winter Roadside Parking

Parking on the shoulder of S.R. 210 adjacent to the Snowbird and Alta ski resorts is a common occurrence since the ski resorts do not have enough parking lot capacity to handle the demand. Roadside parking during the winter can also increase congestion as the travel lane widths are reduced and vehicles slow down as they move through the area. The roadside parking also causes safety concerns with pedestrian-vehicle conflicts as skiers walk along the road to access the resorts. The reduced lane widths also make snow plowing difficult, since the parking limits snow storage and the ability for plow drivers to maneuver through traffic. Additionally, vehicles parked on the south side of S.R. 210 make U-turns in the road when exiting in the afternoon, slowing cars heading out of the canyon, which further reduces mobility. The purposes of reducing or eliminating roadside parking on S.R. 210 would be to improve pedestrian and vehicle safety, improve winter plowing operations by removing vehicles parking on the road shoulders, and reduce travel time.

All of the S.R. 210 mobility alternatives that passed the screening process (see Section 2.2, Improve Mobility on S.R. 210 from Fort Union Boulevard to Alta) would provide additional parking in the Salt Lake Valley and an alternate form of transportation than a private vehicle. Eliminating roadside parking adjacent to the ski resorts is an operational issue that UDOT could implement outside the NEPA process. If UDOT decides to

eliminate roadside parking, there would be enough parking with the alternatives being evaluated in the Salt Lake Valley to accommodate resort users. By eliminating roadside parking, fewer private vehicles would use S.R. 210 in Little Cottonwood Canyon, which would improve overall mobility. Eliminating roadside parking adjacent to the ski areas will be a component of the alternatives evaluated in detail in the EIS.

4.0 Alternatives Advanced for Further Evaluation in the Draft EIS

4.1 Results of the Screening Process

UDOT conducted a screening evaluation of alternatives suggested by stakeholders and in previous studies. The evaluation started with Level 1 screening based on the project's purpose to substantially improve safety, reliability, and mobility on S.R. 210 from Fort Union Boulevard through the town of Alta for all users on S.R. 210. The alternatives that passed Level 1 screening were then evaluated with Level 2 screening in terms of their expected impacts to the natural and built environment.

The alternatives were screened with regard to the following project purpose elements:

- **Improve mobility on S.R. 210:**
  - Mobility on Wasatch Boulevard
  - Mobility on S.R. 210 from Fort Union Boulevard to Alta
- **Improve reliability and safety on S.R. 210:**
  - Avalanche mitigation
  - Trailhead parking
  - Winter roadside parking

Based on the screening process, the following alternative options (designated with square bullets) passed both Level 1 and Level 2 screening:

- **Improve mobility on S.R. 210:**
  - Mobility on Wasatch Boulevard:
    - Imbalanced-lane alternative
    - Five-lane alternative
  - Mobility on S.R. 210 from Fort Union Boulevard to Alta:
    - Enhanced bus service with no widening of S.R. 210 in Little Cottonwood Canyon (24 buses per hour during the peak period)
    - Enhanced bus service in peak-period shoulder lanes on S.R. 210 in Little Cottonwood Canyon (24 buses per hour during the peak period)
    - Canyon gondola with enhanced bus service
- **Improve reliability and safety on S.R. 210:**
  - Avalanche mitigation:
    - Snow sheds with guiding berms
    - Snow sheds and realigned road with no guiding berms
  - Trailhead parking:
    - Trailhead parking improvements with no roadside parking within ¼ mile
    - Trailhead parking improvements with no roadside parking from canyon entrance to Snowbird Entry 1
    - No trailhead parking improvements with no roadside parking from canyon entrance to Snowbird
  - Winter roadside parking:
    - Elimination of winter roadside parking on S.R. 210 adjacent to the ski resorts

4.2 Alternatives Advanced for Further Evaluation in the Draft EIS

To conduct the analysis of the effects of the alternatives on the human and natural environment, UDOT packaged the alternative options into three main alternatives with options to ensure each that alternative met the project purpose of improving safety, reliability, and mobility. These three action alternatives presented in Table 4-1.

After the impact evaluation is performed, UDOT will review the information and identify a preferred alternative in the Draft EIS from the three alternatives listed in Table 4-1. The preferred alternative will include a selection of which options for each element (Wasatch Boulevard, S.R. 210, Avalanche Mitigation, Trailhead Parking, and Winter Roadside Parking) UDOT prefers.

Table 4-1. Alternatives and Options To Be Evaluated in the Draft EIS

Alternative	Purpose Element and Associated Options				
	Purpose Element: Improve Mobility		Purpose Element: Improve Reliability and Safety		
	Wasatch Boulevard Options	S.R. 210 from Fort Union Boulevard to Alta Options	Avalanche Mitigation Options	Trailhead Parking Options	Winter Roadside Parking Options
Enhanced Bus Service with No Widening of S.R. 210 in Little Cottonwood Canyon Alternative	• Imbalanced-lane Alternative • Five-lane Alternative	**Enhanced bus service with mobility hubs at the gravel pit[a] and 9400 South/Highland Drive** • Winter point-to-point bus service from each mobility hub directly to the ski resorts[b] • 24 buses per hour in the peak hour • About 1,008 people on buses in the peak hour • 2,500 new parking spaces divided between two mobility hubs at the gravel pit and 9400 South and Highland Drive • Bus priority on Wasatch Boulevard • Tolling or other management strategies such as no single-occupant vehicles during peak periods	• Snow sheds with berms • Snow sheds and realigned road with no berms	• Trailhead parking improvements with no roadside parking within ¼ mile • Trailhead parking improvements with no roadside parking from canyon entrance to Snowbird Entry 1 • No trailhead parking improvements with no roadside parking from canyon entrance to Snowbird	• Elimination of winter roadside parking on S.R. 210 adjacent to the ski resorts
Enhanced Bus Service in Peak-period Shoulder Lanes on S.R. 210 in Little Cottonwood Canyon Alternative	• Imbalanced-lane Alternative • Five-lane Alternative	**Enhanced bus service with mobility hubs at the gravel pit[a] and 9400 South/Highland Drive** • Winter point-to-point bus service from each mobility hub directly to the ski resorts[b] • 24 buses per hour in the peak hour • About 1,008 people on buses in the peak hour • 2,500 new parking spaces divided between two mobility hubs at the gravel pit and 9400 South and Highland Drive • Bus priority on Wasatch Boulevard • Tolling or other management strategies such as no single-occupant vehicles during peak periods • Winter bus only peak-period shoulder lanes from the North Little Cottonwood Road/Wasatch Boulevard intersection to the Alta Bypass Road; peak-period shoulder lanes would be cyclist and pedestrian facilities in summer	• Snow sheds with berms • Snow sheds and realigned road with no berms	• Trailhead parking improvements with no roadside parking within ¼ mile • Trailhead parking improvements with no roadside parking from canyon entrance to Snowbird Entry 1 • No trailhead parking improvements with no roadside parking from canyon entrance to Snowbird	• Elimination of winter roadside parking on S.R. 210 adjacent to the ski resorts
Gondola Alternative	• Imbalanced-lane Alternative • Five-lane Alternative	**Gondola from the entrance of Little Cottonwood Canyon to Alta Ski Resort** • Winter gondola service starting at the gondola platform at the entrance of Little Cottonwood Canyon with stops at Snowbird ski resort and Alta ski resort only[b] • About 30 gondola cabins per hour • About 1,050 people on gondolas in the peak hour • 2,500-space parking structure at the gravel pit • Enhanced bus service from the gravel pit to the gondola loading platform at the entrance of Little Cottonwood Canyon (there would be no parking at the gondola platform) • Bus priority on Wasatch Boulevard • Tolling or other management strategies such as no single-occupant vehicles during peak periods	• None; gondola could be used when S.R. 210 is closed for avalanche mitigation, similar to existing conditions	• Trailhead parking improvements with no roadside parking within ¼ mile • Trailhead parking improvements with no roadside parking from canyon entrance to Snowbird Entry 1 • No trailhead parking improvements with no roadside parking from canyon entrance to Snowbird	• Elimination of winter roadside parking on S.R. 210 adjacent to the ski resorts

[a] The gravel pit is located on the east side of Wasatch Boulevard between 6200 South and Fort Union Boulevard.
[b] The purpose of the project is to improve winter mobility. Screening criteria did not evaluate the performance of summer service.

5.0 Draft EIS Considerations

UDOT will further refine the action alternatives described in Section 4.0, Alternatives Advanced for Further Evaluation in the Draft EIS, through preliminary engineering before detailed impact analyses begin for the EIS. This preliminary engineering will include details such as horizontal and vertical alignments, potential transit stations or mode transfer locations, and potential drainage designs. Each alternative will be designed to a similar level of detail.

During the preliminary engineering process, UDOT will try to minimize impacts to the human and natural environments. Once the preliminary design work is complete, more-detailed impact analyses will be performed to identify and compare the expected effects of each of the alternatives at an equal level of detail as required under NEPA.

Because the alternatives will undergo a more rigorous engineering design and more-detailed impact analyses, the impact numbers for the alternatives as presented in the Draft EIS will likely vary (positively or negatively) from what has been presented in the Level 2 screening process.

The screening process is designed to be dynamic throughout the EIS process. If a new alternative or refinement of an alternative is developed or arises later in the process, it will be subject to the same screening process as all of the other alternatives.

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