Executive Summary

The Little Cottonwood Canyon Transportation Study focuses on risk assessment and management. The purpose of this study is to:

- Analyze the risk to the highway from avalanches
- Analyze ways to reduce the dependence on artillery
- Develop risk reduction measures
- Develop preliminary costs and associated risks, and
- Provide a blueprint for future avalanche risk reduction projects.

Little Cottonwood Canyon Road, or SR-210, connects the Salt Lake Valley with the Town of Alta, Alta Ski Lifts, and Snowbird Ski Resort at the top of Little Cottonwood Canyon. SR-210 is a state highway, so the operation and maintenance is the responsibility of the Utah Department of Transportation (UDOT). The partnership between UDOT's snow safety staff and the snow safety managers at Alta and Snowbird is a critical component of Little Cottonwood Canyon's success: without the diligent and effective teamwork of these individuals, Little Cottonwood Canyon would represent a far greater hazard. Much is owed to these teams, and they deserve continued recognition and support. The road is the only access for the communities, resorts, trailheads, and private properties along the canyon's length. Part of Little Cottonwood Canyon is federally designated Wilderness Area, with quite severe restrictions. Other land ownership includes the Wasatch-Cache National Forest, the Town of Alta, and privately held lands.

Project Sponsors

This project relied heavily on the trust and good will of all participants. The sponsors of the project included:

- UDOT
- UTA
- Alta Ski Lifts
- Snowbird
- Town of Alta

Other participants included:

- United States Forest Service
- Salt Lake City Public Utilities
- Salt Lake County Planning and Public Safety
- Wasatch Front Regional Council
- Save Our Canyons

The consultant team was led by Fehr & Peers Associates, with support from:

- Chris Stethem and Associates
- HW Lochner
- Bio-West
- Carter-Burgess
- Penna Powers Brian Haynes

Methodology

The study relied on a methodology called the Avalanche Hazard Index (AHI) to understand the existing risk and evaluate alternatives. The AHI has several important variables that are calculated, including the frequency of the slides reaching the road, the quantity of paths along the corridor, and the volume and speed of traffic. These factors all contribute to the risk to vehicles along Little Cottonwood Canyon. The table below shows the range of risk for the AHI.

Hazard Category	*Avalanche Hazard Index*
Very Low	<1
Low	1 to 10
Moderate	10 to 40
High	40 to 150
Very High	>150

Current Conditions

According to the AHI methodology, Little Cottonwood Canyon is one of the highest-risk roads in North America. There are times of the season when the risk is around 1,000. However, with the control program and the bypass road in use, the AHI hovers near 100: still high, but roughly 10% of the risk without the control program and bypass road in place. Snow safety operators agree that Mid-Canyon (the section of canyon surrounding White Pine and Little Pine slide areas) is the most risky.

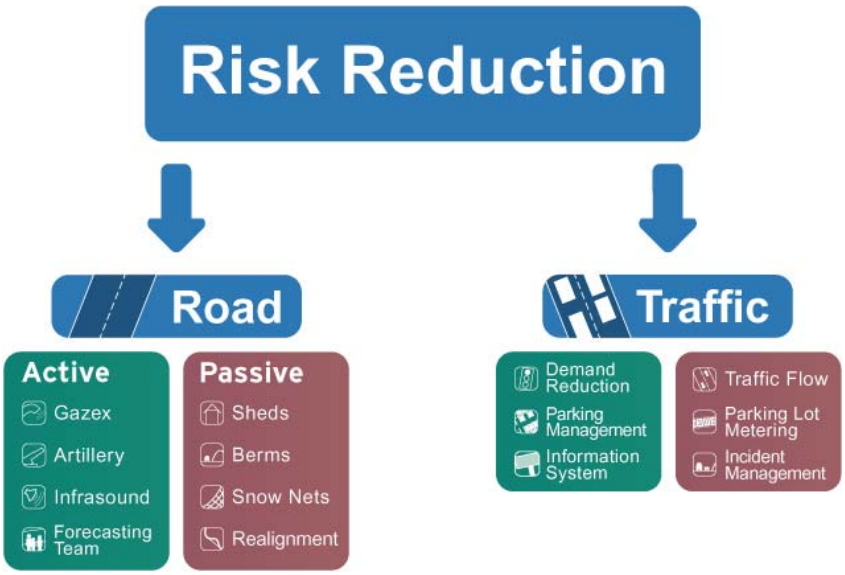
Traffic has held fairly constant over the last several years with Average Daily Traffic around 5,000 vehicles while peaking around 8,000 cars during heavy use. Congestion during these peak days is a major contributor to the high hazard rating. UTA, the local transit provider, has a very successful ski bus service and play a major role in the success of the transportation system to date. They operate service from TRAX stations and also serve several park-and-ride lots located along the foothills of the Wasatch.

Constraints

Many environmental and jurisdictional constraints limit activity in Little Cottonwood Canyon, and were identified in this study. Little Cottonwood Canyon is an important watershed for the Salt Lake Valley, and has many water-related features such as wetlands and Little Cottonwood Creek that require protection. The canyon contains considerable areas of wildlife habitat, as well as major recreation areas popular among many Utah residents. Two designated wilderness areas, Lone Peak and Twin Peaks, are within the boundaries of Little Cottonwood Canyon. The wilderness designations affect implementation of several risk reduction strategies discussed in this study.

Alternatives

There are two very fundamental ways to lower the AHI: change the road and how avalanches affect it, or change traffic characteristics. The graphic below illustrates the strategies evaluated in this study, and how they relate to these two fundamental methods.



The two ways to change the road can be categorized into "active" and "passive" measures. Active measures influence how snow is managed by technology and/or people. Active measures analyzed in this study include Gaz-ex exploders; increasing the current artillery program; and using infrasound to improve slide detection. Passive measures are structural changes to the road. They are permanent and as such can have impacts to the built and natural environment in the canyon. Examples of passive measures analyzed in this study include realigning the road to avoid slide paths; constructing snow sheds so that snow goes over the road; and building berms to deflect or absorb as much of the slide as possible.

The other fundamental way to influence the AHI is by changing traffic. As traffic increases, speeds and distance between cars decrease, the AHI rises. Reducing the number of cars on the road allows the remaining cars to go faster, which decreases the avalanche risk. This can be accomplished through increased transit service; better use of park-and-rides; improved travel information for drivers; and making sure traffic exits the resorts at day's end in an efficient manner.

Recommendations

This study developed several recommendations that can be implemented with relative ease and low to moderate cost. These **short term** recommendations include:

- Additional artillery in the mid-canyon area for the White Pine Chutes
- Infrasound detectors
- Improve berms, especially at White Pine
- Install Gaz-ex at the Hilton slide above Snowbird
- Rural ITS grant for park-and-ride management, and for improvements to canyon communication
- Explore driveway metering at resort driveways
- Pursue funds for an environmental study
- Stakeholders continue to meet about these recommendations and long term options on a quarterly basis

The **long term** options to reduce risk in Little Cottonwood Canyon may take many paths. Chapter 3 of this report outlines many of the options and their respective reduction in risk and potential issues for implementation. They all have tradeoffs in terms of cost, time, risk reduction, and level of effort for permits and clearances. There are several long term options discussed in the table below, including:

Option	Issue
Transit-only such as buses or trains	Park and ride locations, cost, impacts
Snow Sheds	Cost, visual impacts
Road Realignment	Cost, impacts, wilderness area, wetlands and watershed issues, access
Snow Fences	Cost and visual impacts
Gaz-ex control devices	Wilderness issues (and slides will still reach the road)
Tunnel	Cost, access

The intent of this study was to explore, analyze and present long term options; not have a single preferred option. Because the long term solution may include a combination of options, with relative high costs, and likely high levels of regulatory hurdles, there are no specific long term recommendations. Those should be decided through a more formal process with a collaborative environmental study, including a high level of public participation. This is discussed in more detail in Chapter 4.

In the meantime, there are two programs in place which should be further encouraged. The first is continued promotion of alternatives to the private vehicle. Increased bus service and transit amenities should be encouraged. The added amenities at Snowbird's Creekside Lodge (shown at right) are excellent examples of how the resorts can support transit use.

Second, continue to support the "human element" of canyon operations. SR-210's great safety record is due to the high level of dedication, training, and collaboration of UDOT, Salt Lake County Sheriff, USFS, and resort snow safety personnel. This public/private partnership has functioned well, albeit with some bumps along the way, for many years. Regardless of future technology, infrastructure, or changes in the way the canyon risks are managed, this human element must be continued.