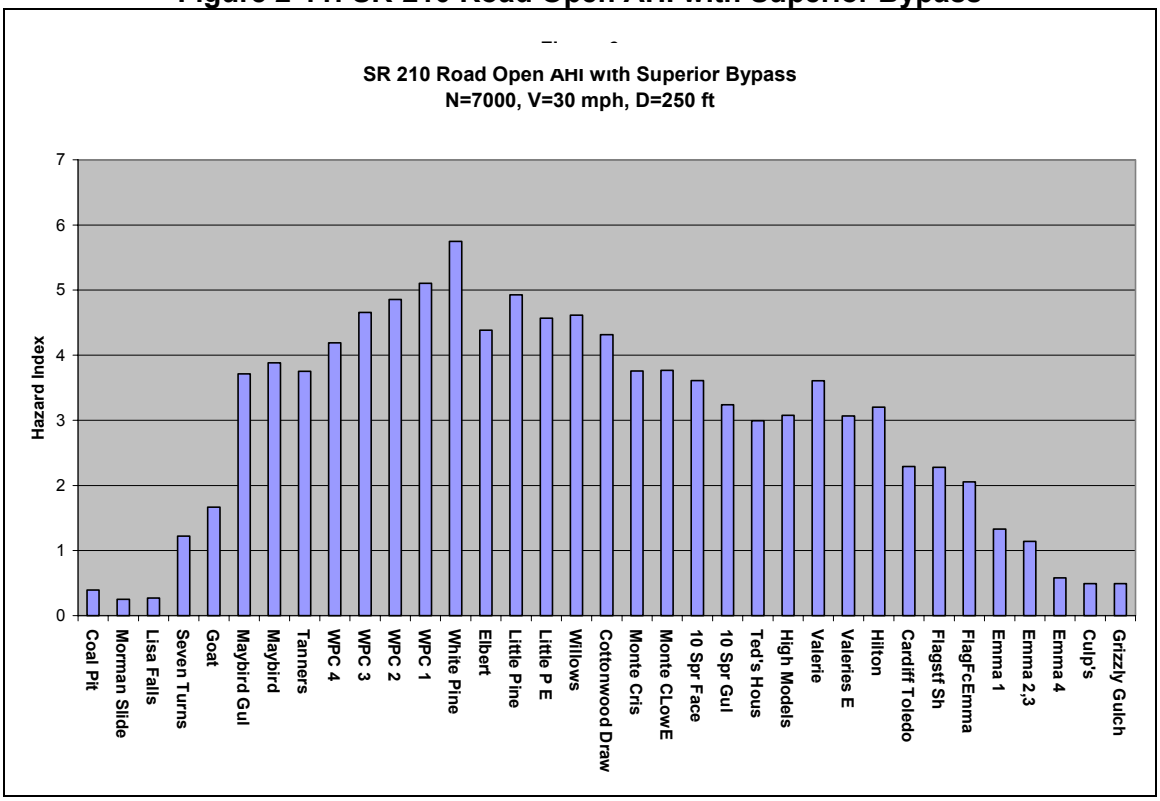
Figure 2-11: SR-210 Road Open AHI with Superior Bypass



The highway open AHI hazard for SR-210 with the Superior Bypass in place is 103 or a high hazard. This is a very significant risk for an open road and solutions should be explored to reduce this to at least a moderate hazard (<40). At Rogers Pass, British Columbia, a combination of structural control measures and active artillery control has been used to reduce a very high hazard route to a current road open hazard of moderate. On SR-210, the greatest contributor to the road open risk is White Pine; however the risk is spread over a number of paths in the Mid-Canyon and Snowbird groups. This underlines the need for measures which will address the hazard at several avalanche paths in each of the Mid-Canyon and Snowbird areas.

Canyon Section Priority

While each of the canyon sections discussed above have unique characteristics and avalanche risks, some sections are more hazardous than others. The Town of Alta section is essentially one continuous runout zone, and represents the greatest avalanche threat to occupied buildings. The Snowbird Village section also has a considerable avalanche hazard risk to structures and occupied areas. However, the Bypass Road enables traffic to avoid both of these sections. Since the focus of this study is to reduce avalanche hazard to vehicles (rather than reducing hazard to structures), most of the future alternatives and solution packages will focus on the Mid-Canyon section of SR-210.

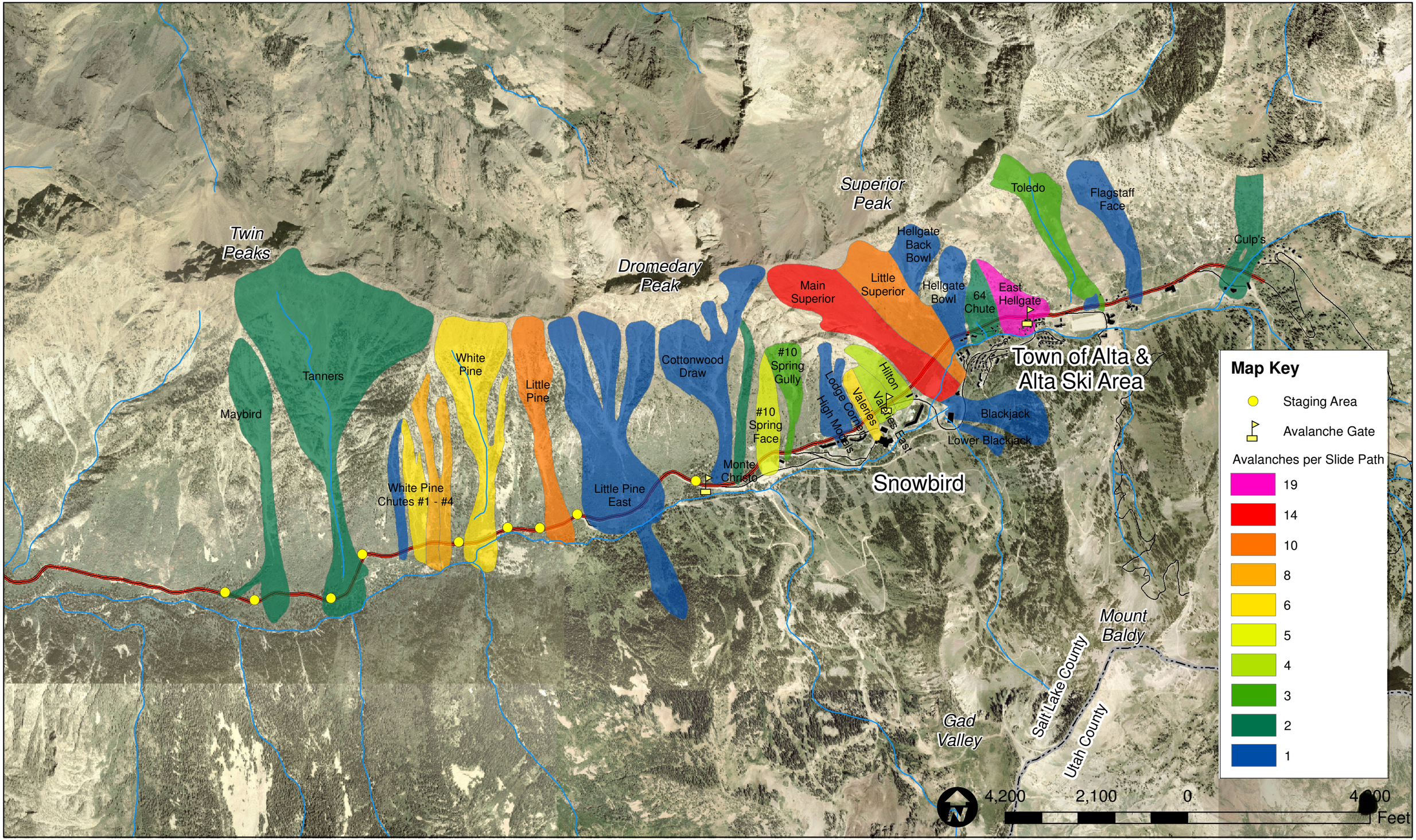


Figure 2-12: Natural and Controlled Avalanches by Path, 1995 - 2005

Sources: Utah State Automated Geographic Resource Center (County Boundary Line, Lakes, and Streams), Town of Alta (Roads, Structures, Staging Areas, Avalanche Gates) Note: The data presented is subject to error.

Snow Safety Operations

UDOT addresses avalanche safety on SR-210. UDOT inherited this responsibility from the Forest Service in the early 1980's. Although many similarities exist between the present program and the early days of avalanche work in this canyon, several features have been added since the program's inception:

- Numerous remote weather stations feed data to the UDOT Highway Avalanche Forecast Office on a continual basis from late fall to late spring. UDOT uses specialized software to expediently analyze and record this information.
- UDOT has a seasonal staff of four full time avalanche forecasters stationed in the canyon; these forecasters work closely with the snow safety departments at the local ski areas to coordinate on highway avalanche decisions.
- UDOT uses three military weapons for highway avalanche control work in Little Cottonwood Canyon: two 105 mm Recoilless Rifles and one 105 mm Howitzer. These weapons are located on U.S. Forest Service lands within the Alta and Snowbird Ski areas, and are staffed by Alta and Snowbird Ski Patrol members working under UDOT's direction. These three weapons fire an average of 495 rounds of ammunition each year for highway avalanche control work.
- UDOT contracts with the local Helicopter Ski operators to supplement the use of artillery.
- A trailer-mounted Avalauncher is occasionally used to test and control certain avalanche paths affecting the road, when extensive work by artillery is not deemed necessary.
- UDOT installed an avalanche track sensor in one of the more frequently-running avalanche paths affecting the road. This device provides immediate notification of avalanche activity in that area, and UDOT is considering using Geo-phones as additional avalanche detection devices for more paths.
- Plans call for the installation of a remote surveillance camera on the south side of the mid-canyon area to observe conditions, avalanche activity, and accuracy of artillery fire above this section of the road.
- A partnership between various government agencies and the private sector has been established to assist UDOT in the Highway Avalanche Safety Program. This partnership is the foundation on which the safety program is built, and it is necessary for continued success.

While the avalanche hazard on SR-210 is remarkably high, the agencies charged with keeping the road safe for travel have done a remarkable job for nearly six decades under extremely challenging conditions. Avalanche accidents on SR-210 are surprisingly infrequent in spite of a potential for accidents that is quite high. While hard work and a sound program contribute to the success of the snow safety operations, the existing procedures may not adequately address public safety concerns. In other areas (i.e., Rogers Pass in Canada, Red Mountain Pass in Colorado) the risk to motorists from avalanche events was significant enough to warrant construction of snow sheds and other permanent measures to augment or replace active control work. Continuing to rely solely on forecasting, closure, and control may lead to more frequent road closures and the continued possibility of unanticipated natural avalanches causing injury or death. Another important consideration is that the current program relies heavily on military artillery to control the avalanche paths above the canyon road, the Village of Snowbird, and the Town of Alta. Numerous safety and security concerns, as well as environmental issues, surround the use of military artillery in an area such as Little Cottonwood Canyon; any of these issues, as well as limits to the supply of weapons and ammunition, could result in termination of the artillery program.

Economic Impact of Avalanche Hazards

According to Road Closure: Combining Data and Expert Opinion (Blattenberg and Fowles, 1994), the economic implications of road closures on ski resorts are significant. For the 1991 – 1992 ski season, average daily traffic on SR-210 was 5,710. Each of these vehicles had an average of 2.6 persons per vehicle, 2.5 of which were assumed to be skiers. Of these skiers, 40% tended to be residents, who spent an average of $19 per day at the ski resorts; 60% tended to be non-residents, who spent an average of $152 per day at the ski resorts. Using these figures, a road closure during the 1991 – 1992 ski season meant the loss of $1,410, 370 per day in revenue for the resorts. This amount would be higher in 2005 dollars, given inflation rates and cost increases for lift passes and lodging.

Transit

The Utah Transit Authority (UTA) began offering transit service to Big and Little Cottonwood Canyon ski areas in 1976. The service has grown and developed over the years, and today UTA provides service to the Alta and Snowbird Ski Resort in Little Cottonwood Canyon and the Solitude and Brighton Ski Resorts in Big Cottonwood Canyon. As of 2005 ridership records, total ski service is composed of approximately 65% Little Cottonwood Canyon ridership and 35% Big Cottonwood Canyon ridership. During the 2004-2005 ski season, ridership in Little Cottonwood Canyon was split approximately 40% Alta and 60 % Snowbird.

Current Services

UTA provides bus service to the Snowbird and Alta ski resorts in Little Cottonwood Canyon. The service is seasonal, operating from November to April. Route 98 is the route serving Little Cottonwood Canyon. This route originates at the Midvale Fort Union TRAX station, travels Fort Union Blvd, 2300 East, and then 9400 South to Little Cottonwood Canyon Road. An intra-canyon shuttle is also provided for travel between the canyons and ski resorts. Stops for this Route include the Midvale Fort Union TRAX station, the 6600 S 950 E park and ride lot, 2000 E and 9500 South, the 9400 South Park and Ride lot, Snowbird, Cliff Lodge, Goldminer's Daughter, and Alta. Additional route information, including bus times and detour information, is provided on the UTA website between November and April (www.rideuta.com). Bus passes fares for the ski service were increased last year. The only future planned rate increases for the ski shuttles are for the intra canyon shuttle in 2006. The intra-canyon shuttle rate will be $1.60 effective 1/1/06. Table 2-6 provides bus fare information for the 2004 – 2005 seasons.

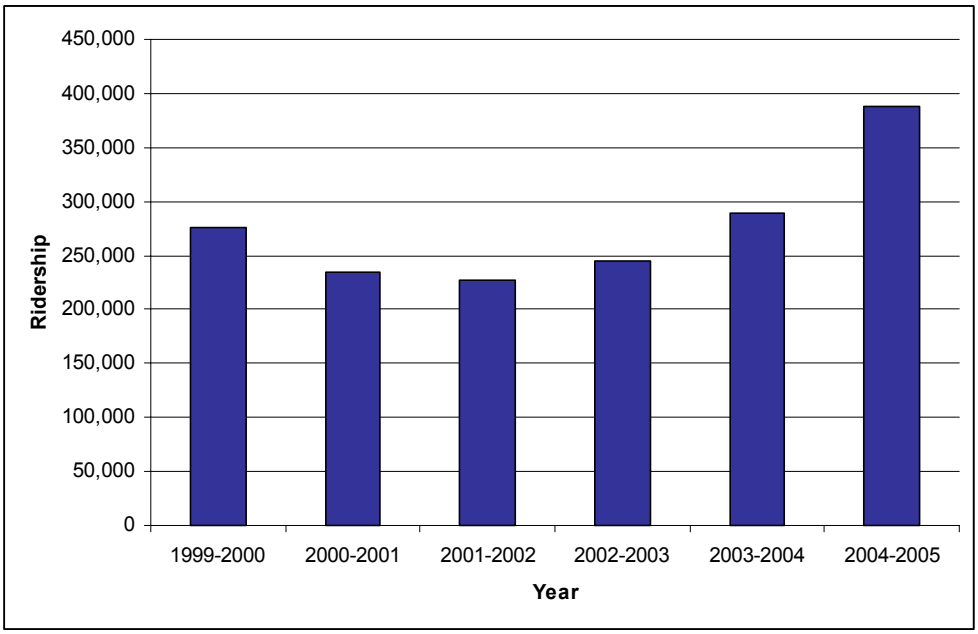
Table 2-6: 2004 – 2005 UTA Ski Service Bus Fares

Fares	*Effective 1/1/04*	*Effective 1/1/05*
Ski Pass One-way	$2.50	$3.00
Ski Pass Two-way	$5.00	$6.00
Intra Canyon Shuttle	$1.25	$1.25
Source: UTA 2005		

Historical Ridership

Despite the recent increase in fare price, UTA's ski bus ridership continues to increase. In fact, ski service ridership increased 35% between 2003 – 2004 and 2004 – 2005 seasons. Figure 2-13 displays total annual ski service ridership from 1999 to 2005.

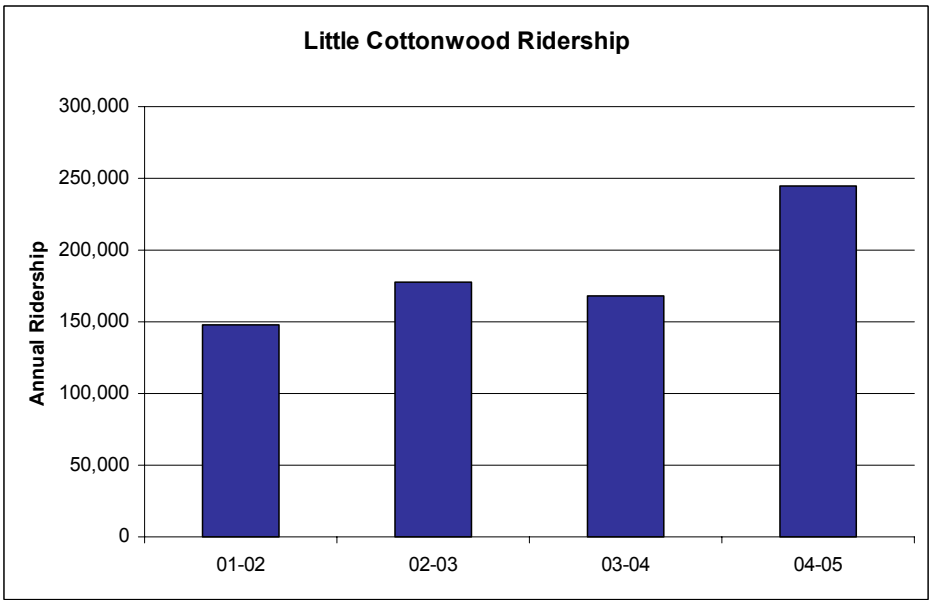
Figure 2-13: UTA Total Ski Service Annual Ridership 1999 – 2005



As shown in Figure 2-13, bus ridership changes from year-to-year; however, the overall trend is an increase in bus ridership over the past five years.

Figure 2-14 presents historical ridership information for Little Cottonwood Canyon.

Figure 2-14: UTA Little Cottonwood Canyon Annual Ridership 2001 – 2005



As shown in Figure 2-14, bus ridership in Little Cottonwood Canyon increased 65% between 2001 and 2005.

Existing Ridership

During the 2004 – 2005 winter season, almost 245,000 passenger trips were completed in Little Cottonwood Canyon using the UTA ski bus service. Figure 2-15 displays average daily ridership by month for Little Cottonwood Canyon for the 2004 – 2005 season.

Figure 2-15: UTA Average Daily Little Cottonwood Canyon Ridership 2004 – 2005

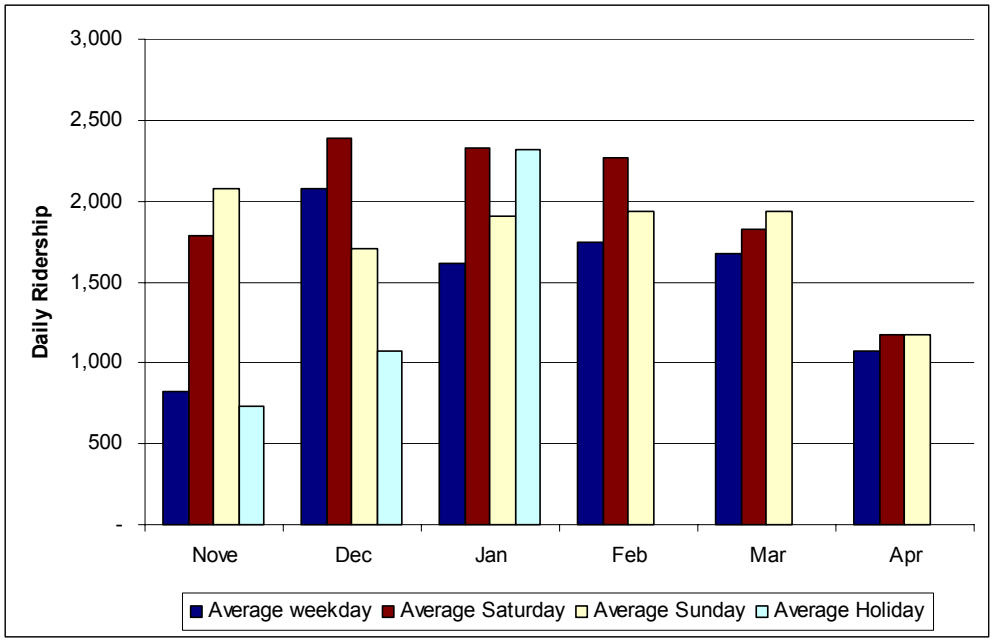


Figure 2-15 shows that average ski ridership is highest on Saturdays. The section entitled Existing Traffic of this report indicates that the highest traffic volume days for Little Cottonwood Canyon are also Saturdays. For February 2005 the average daily traffic on SR-210 was approximately 12,000. Bus ridership for this month divided by average daily traffic is approximately 20%. Without UTA ski service, traffic in the canyon could be as much as 20% higher during this peak month.

SR-210 Non-Winter Issues

The focus of this study is to reduce the avalanche hazard to vehicles on SR-210. However, other non-winter safety issues exist that can be briefly addressed here, but require further examination outside of this report. The primary non-winter safety concern mentioned by stakeholders relates to bicyclists. SR-210 is not currently designated as a bike route, nor does it have a bike lane. In fact, many parts of SR-210 have inadequate shoulder widths to safely accommodate cyclists. Regardless, SR-210 is extremely popular with cyclists. The annual Snowbird Hill Climb is a road race from 9400 South and 2000 East to Snowbird's Entry 2, for a total distance of ten miles and an elevation gain of 3,500 feet. This attracts several hundred racers every year in late summer. SR-210 is also popular with individual cyclists, though the road's steep grades and narrow shoulders may discourage beginner riders.

The 2006 – 2010 Wasatch Front Regional Council (WFRC) Transportation Improvement Program (TIP) does not include any planned bicycle improvements for SR-210. However, a Big

and Little Cottonwood Canyons Spot Safety Study completed for UDOT in June of 2005 identified segments of SR-210 where the eastbound shoulder is particularly narrow. The study recommended widening the shoulder along these segments to accommodate eastbound, uphill-heading cyclists. The westbound shoulder is less of a concern because cyclists frequently reach sufficient downhill speeds to travel with the traffic flow.

In 2005, a student group associated with the University of Utah Civil Engineering Department completed an engineering study for bicycle facilities on SR-190, Big Cottonwood Canyon Road. UDOT may wish to commission a similar study for bicycle facilities on SR-210, or complete another feasibility-type analysis to further discussions of bicycle improvements in Little Cottonwood Canyon.

Roadway Infrastructure

SR-210 is a Class Four (Regional Rural) UDOT facility between 9400 South and the Alta Ski Resort in Little Cottonwood Canyon. The road primarily serves recreational traffic and traffic trends vary greatly from season to season. The road is characterized by steep grades, several sharp bends, and often inadequate shoulders.

Laneage

SR-210 in Little Cottonwood Canyon is predominantly a two-lane roadway; however passing lanes begin approximately at mile post 8.5 and continue eastbound for about a thousand feet.

Driveways

According to UDOT Access Management Standards (Administrative Rule R930-6), driveways on SR-210 should be spaced a minimum of 500 feet apart. The existing driveway spacing on SR-210 meets this spacing; however, recommendations for specific driveway improvements such as sight-distance and intersection control alternations will be further studied during winter roadway conditions.

Speed Limits

The speed limit along most of SR-210 is 40 mph. The speed limit decreases to 25 mph eastbound at the approach to the Snowbird Resort. The speed limit remains 25 mph through the Snowbird and Alta Ski Resort areas. Westbound the speed limit increases from 25 mph to 30 mph upon exiting the Snowbird area. The speed limit increases from 30 mph to 40 a few hundred feet after exiting the Snowbird Resort area and continues at 40 mph through 9400 South.

Overview of Geometric Deficiencies

Geometric deficiencies were surveyed and included in the Big and Little Cottonwood Canyons Spot Safety Study completed for UDOT. A summary of the deficiencies that should be addressed immediately is listed in Table 2-7 and Table 2-8.

Table 2-7: Guardrail Deficiencies

Mile Post	*Station*	*Right*	*Left*	*Length*	*Improvement*
8	1506	R		100	2' Asphalt, Guardrail
7	900	R		600	Guardrail
7	0	R		520	Guardrail
4	900	R		3650	2' Asphalt, Guardrail
3	1070	R		510	Guardrail
2	4500	R		1160	Guardrail
Source: Big and Little Cottonwood Canyons Spot Safety Study, HNTB					

Table 2-8: Shoulder Width Deficiencies

Mile Post	*Station*	*Length*
4	900	3650
4	5150	730
5	970	755
6	4935	345
7	2075	455
7	2680	1620
8	1256	784
8	2810	2820
9	1275	2870
10	1535	105
10	3875	1680
11	900	150
Source: Big and Little Cottonwood Canyons Spot Safety Study, HNTB		

Improvements that should be considered in the future as more funding becomes available are listed in Table 2-9.

Table 2-9: Future Recommended Guardrail Improvements

Mile Post	Station	Right	Left	Length	Improvement
10	1280	R		250	Guardrail
9	2395	R		200	Guardrail
8	980	R		276	Guardrail
8	4035	R		590	Guardrail
8	3815	R		220	Guardrail
7	2530	R		150	Guardrail
6	4125	R		560	Guardrail
6	3600	R		525	Guardrail
6	3000	R		600	Guardrail
6	2100	R		900	Guardrail
6	1800	R		300	Guardrail
Source: Big and Little Cottonwood Canyons Spot Safety Study, HNTB					

The Utah Statewide Transportation Improvement Program (STIP) Fiscal Years 2006 through 2010 outline clearzone (shoulder related) safety improvements for Big and Little Cottonwood Canyons. There are no additional improvements outlined for SR-210 in the UDOT Long Range Plan.

Turnout Locations

Between the mouth of the canyon and the first entrance to Snowbird a few shoulders are large enough to provide space for stalled or stopped vehicles; however, no designated turnout locations are provided. This can be a problem during the winter months if stalled or stopped vehicles block travel lanes and cause queues to form in avalanche path areas.

Parking Inventory

Existing parking inventory was provided by the Final Environmental Impact Statements (FEIS) for the Master Development Plans (MDP) of both Snowbird and Alta. Figure 2-16 displays the parking locations, and Table 2-10 and Table 2-11 indicate the number of spaces near both resorts. While the EIS for Snowbird's MDP does not identify any future parking expansions, Alta's MDP FEIS lists a parking expansion of 28 spaces at the upper Grizzly lot. However, the Wasatch Cache Revised Forest Plan states that parking expansions in Little Cottonwood Canyon are not acceptable, except to replace parking lost due to mass transit facilities.

Table 2-10: Snowbird Existing Parking Inventory

ID #	*Parking Location*	*Number of Spaces*
S1	Entry 1 to Gad Valley	134
S2	SR-210 Roadside	195
S3	Gad Valley	531
S4	Wilbere to Maintenance Shop	119
S5	Entry 2	59
S6	Main Lot	228
S7	Iron Blosam	84
S8	Employee Parking	99
S9	The Inn/Lodge at Snowbird	89
S10	The Strip (HOV)	104
S11	Upper Circle	20
S12	Employee Housing	86
S13	Superior Lot	276
S14	Cliff Lodge Area	266
S15	On Ramp	22
S16	Parking Structure	180
S17	Bypass Road	230
	Snowbird Total	**2,722**

Table 2-11: Alta Existing Parking Inventory

ID #	*Parking Location*	*Number of Spaces*
A1	Goldminer's to Bypass Road	77
A2	Main	831
A3	Employee Main	78
A4	Deep Powder House South	63
A5	Goldminer's Guest	50
A6	Alta – Rustler Lodge	179
A7	Fire Station – Forest Service	113
A8	Snowpine – Fire Station	90
A9	Snowpine	290
A10	Albion	465
A11	Grizzly & Road	210
	Alta Total	**2,446**

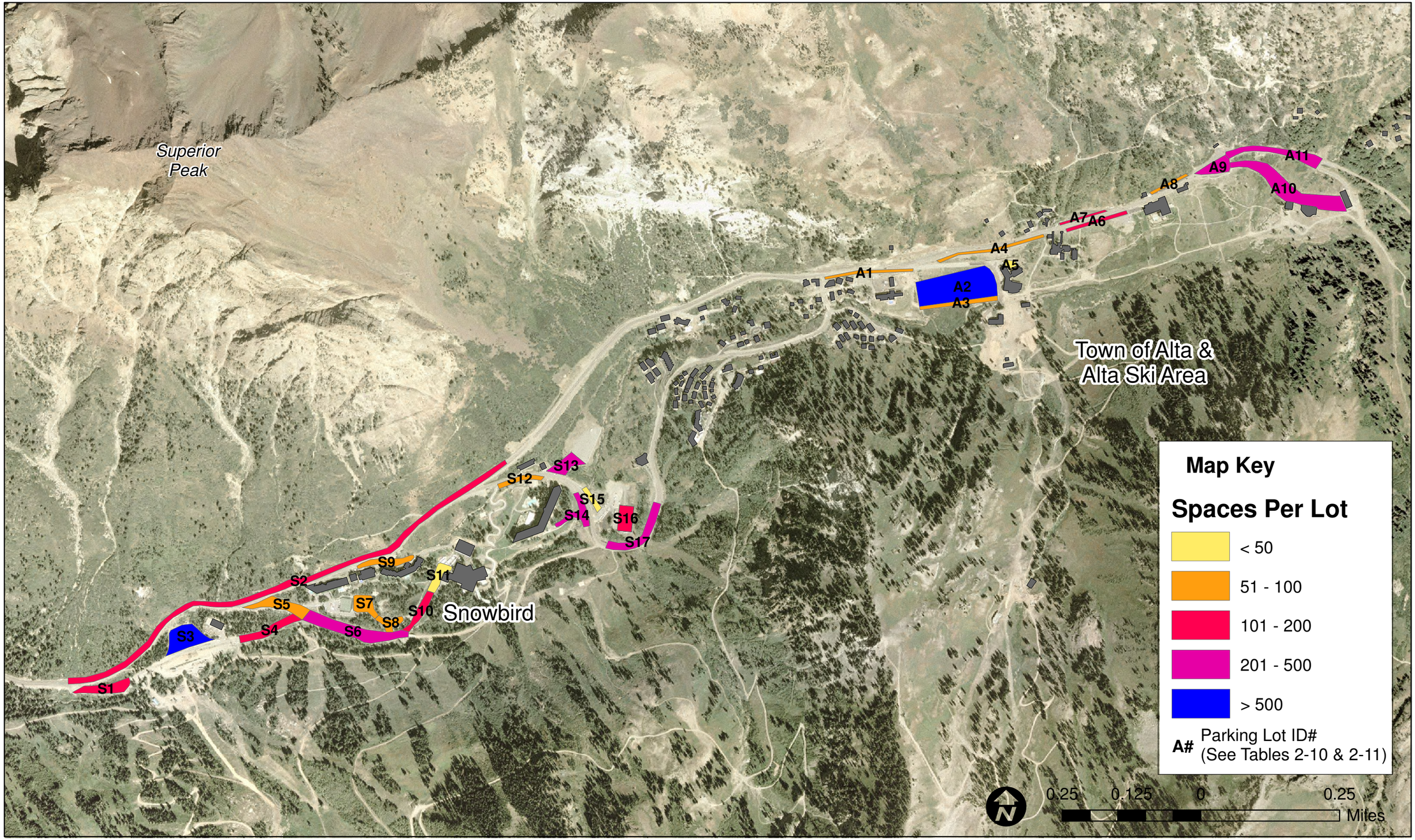


Figure 2-16: Alta and Snowbird Parking Inventory

Sources: Utah State Automated Geographic Resource Center (Aerial Photo), Town of Alta (Roads, Structures) Note: The data presented is subject to error.

For canyon users who wish to ride UTA, several park-and-ride locations are dispersed throughout the southeast end of the valley. Table 2-12 lists those park-and-ride lots which connect transit riders to Alta/Snowbird ski bus routes.

Table 2-12: Alta/Snowbird Park-and-Rides

Location	*Owner*	*Spaces*	*Average Weekday Usage*	*Percent Full*
Midvale Fort Union TRAX Station	UTA	266	219	82%
6450 South Wasatch Boulevard	Salt Lake County	182	51	28%
Mouth of Big Cottonwood Canyon	Salt Lake County	102	87	85%
6600 South 950 East	Salt Lake County	130	26	20%
9400 South 2000 East	UTA	401	109	27%
Mouth of Little Cottonwood Canyon	Salt Lake County	162	156	96%
8100 South Wasatch Boulevard (Alta/Snowbird Employee Lot)	Salt Lake County	56	39	70%

Maintenance

UDOT has a six-man maintenance crew responsible for both Big and Little Cottonwood Canyons, as well as part of I-215. During the winter, this crew frequently works until 10:00 p.m., sometimes later, clearing snow in the canyons; in addition, they often begin work again at 4:00 a.m. the next morning. This crew has access to some of the highest quality, most technologically advanced equipment available, but they still face problems in the canyons. The most pressing problem for maintenance regards communication: there are a number of “dead zones” in both canyons, where no communication equipment will function. In Little Cottonwood Canyon, these zones are near the mouth of the canyon, as well as at the top of the canyon. This creates problems for communication not only within this UDOT maintenance crew, but also with other agencies such as the Salt Lake County Sheriff and UTA.

Another problem relates to the increase in private residences up both canyons. In the past, canyon residents subscribed to a computerized notification system managed by UDOT, which was programmed to inform residents via automated phone call in advance of canyon road closures. However, in recent years the canyon residents have decided to end participation in this program. As a result, these same residents are on their own to stay abreast of road closure information. UDOT maintains a 511 phone line, which canyon denizens may call to learn about road closures, and the Town of Alta provides updated information on the AM 530 radio station through the Alta Resort Association. Nevertheless, many canyon residents call maintenance crews (sometimes at their home phone numbers) to learn about road closures.

Maintenance costs are considerable in Big and Little Cottonwood Canyons. This is due to the significant amount of money spent on avalanche control measures, as well as the snow removal that must take place during the winter – not only because of normal snowfall, but because of avalanche debris hitting the road. Table 2-13 presents general maintenance costs for Little Cottonwood Canyon for 2003 – 2005.

Table 2-13: Little Cottonwood Canyon Maintenance Costs, 2003 - 2005

Fiscal Year	*Cost Category*	*Annual Expenditure*
2003	Regular Maintenance	$65,740
	Snow Removal	$319,403
	Avalanche Control	$200,330
	2003 Total	**$585,473**
2004	Regular Maintenance	$117,800
	Snow Removal	$723,477
	Avalanche Control	$189,330
	2004 Total	**$1,030,607**
2005	Regular Maintenance	$61,490
	Snow Removal	$491,755
	Avalanche Control	$198,608
	2005 Total	**$751,853**
	Three-year average	**$789,311**

Existing Traffic

As previously mentioned, traffic conditions in Little Cottonwood Canyon are greatly influenced by seasonal and environmental factors. The predominant traffic destinations for Little Cottonwood Canyon are the natural recreational and resort attractions of the canyon. The majority of these trips come from the Salt Lake Valley. Over the past decade average annual daily traffic (AADT) up the canyon has not increased (5,745 in 1995 and 5,625 in 2004); however, traffic congestion in the canyon remains a problem on peak days and peak times.

Historical Traffic Volumes

Average daily traffic demand for Little Cottonwood Canyon has stayed around 5,500 for the past decade. Figure 2-17 shows average annual daily traffic at the national forest boundary (approximately ½ mile west of the intersection with SR 209) between 1995 and 2004.

Figure 2-17: Average Annual Daily Traffic 1995 - 2004

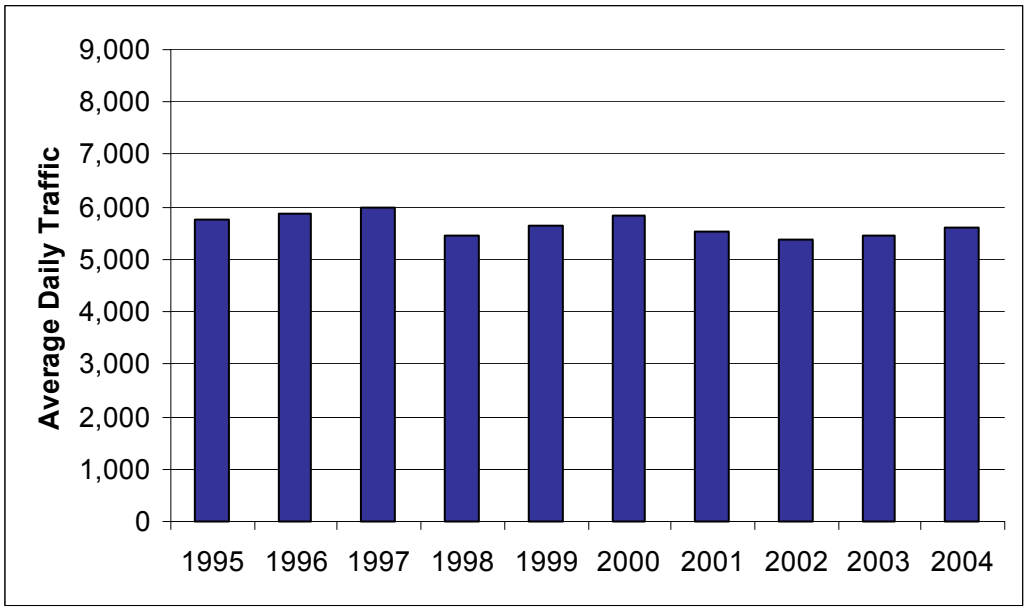
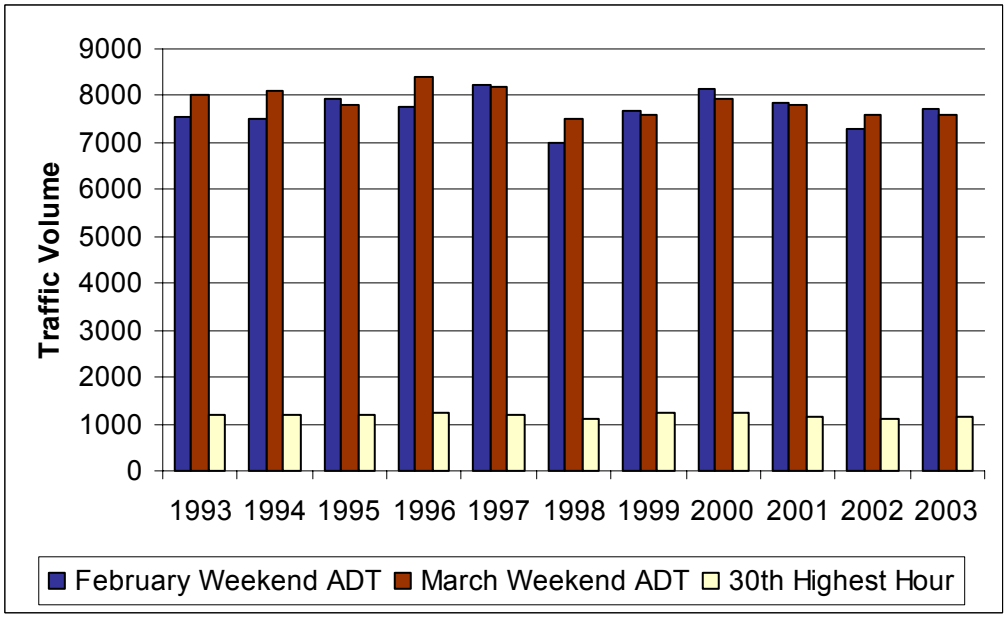


Figure 2-17 shows that while traffic varies from year-to-year, historically traffic volumes have not increased substantially over the past 10 years. However, it is also important to consider average traffic during peak month conditions and peak hour traffic volumes for Little Cottonwood Canyon. Figure 2-18 displays average daily traffic for weekends in February and March and for the 30th highest hour of the year (1993 – 2003). February and March are the highest traffic volume months for Little Cottonwood Canyon, and state-of-the-practice standards recommend designing roadways for the 30th highest hourly traffic volume.

Figure 2-18: ADT Peak Months and 30th Highest Hour Traffic Volumes (1993 – 2003)



As shown in Figure 2-18, average daily traffic on weekends in February and March are 2,000 – 3,000 vehicles higher than the average for the year. The 30th highest hour traffic volumes