

Bridal Veil Falls Avalanche 1996

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ABSTRACT

Bridal Veil Falls avalanche path released January 31, 1996. The resulting avalanche ran down to and across the floor of Provo Canyon. It continued up the opposite side of the canyon, crossed US Highway 189 and destroyed the power lines beyond the highway. It also blew two railroad cars about fifty meters and severely damaged the base terminal of the four passenger tram. This was part of a much larger avalanche that included two more drainages south of Bridal Veil.

Located in the Wasatch Mountains of Utah, Provo Canyon is at 40° 21' north latitude, 111° 36' west longitude. Provo Canyon has the three largest slidepaths that threaten a highway in the state of Utah. They are Bridal Veil Falls, Lost Creek, and Slide Canyon. The starting zone and track of Bridal Veil have an area of approximately 160 hectares and a vertical drop of 1626 meters. An interesting feature of the track is a cliff just above the runout zone. About 120 meters in height, the cliff has a perennial waterfall that the slidepath is named after.

The storm cycle that produced the Bridal Veil Falls avalanche began January 16, and by the 31st had dropped 239 centimeters of snow (H₂O equivalent 181 millimeters) on the Utah Department of Transportation (UDOT) snow study plot at Aspen Grove (see precipitation table). Total snow depth at Aspen Grove (elevation 2100 meters) was 18 centimeters on January 16 and 122 centimeters on the 31st. The ten days before the storm cycle was clear with no precipitation. Before the storm cycle the snowpack was 76 centimeters deep at the Sundance study plot at 2438 meters, and was weak recrystallized snow. On January 31 the total depth at the Sundance study plot was 254 centimeters.

UDOT did avalanche control (with positive results) on the north side of Provo Canyon on the 18th and the 28th. Avalanche control work by UDOT on February 1 triggered an avalanche in Slide Canyon that ran to within about ninety meters of US 189. Slide Canyon drains into Provo canyon from the north, about two kilometers northeast of Bridal Veil Falls (see map). UDOT does not do avalanche control in any of the avalanche paths on the south side of Provo Canyon with the exception of the Deer Creek Dam Chute.

During the helicopter bombing mission on the 28th I could see avalanche debris in the track of Bridal Veil Falls. A post control flyby of Bridal Veil resulted in an estimate by the chief guide of Powderbirds helicopters that only about 20% of the path had released. This information was relayed to me late on the 29th. By early morning on the 30th twenty five centimeters of snow (H₂O equivalent 27 millimeters) had fallen at the UDOT study plot overnight. Snow continued falling at the rate

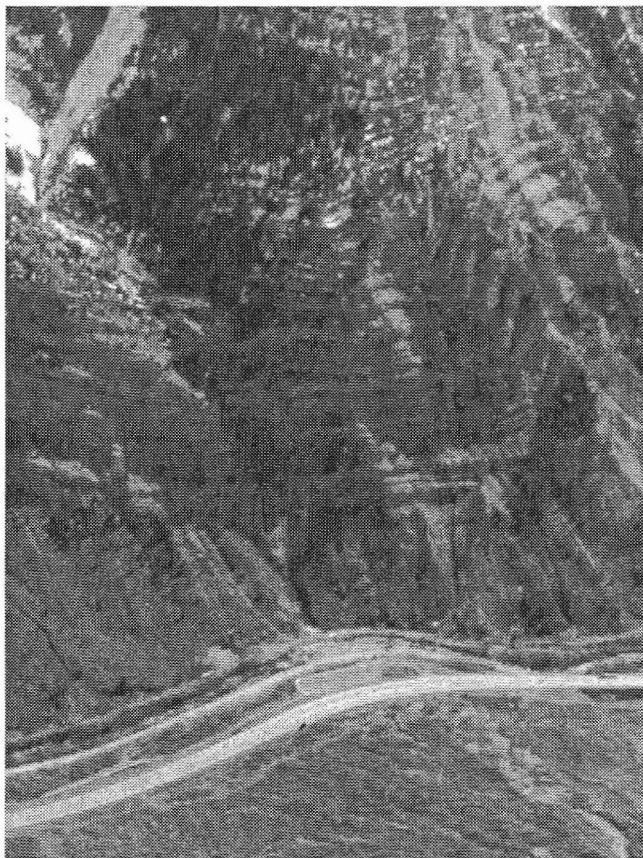
of 2 to 3 cm/hour, with more snow forecast. Average windspeeds at the summit (elevation 2515 meters) of Sundance Ski Area for this period were in the range of 9 to 16 meters/ second.

Some facts about the wind data are in order here. The only local wind data available is provided by Sundance Ski Area. The Sundance summit weather station has the highest anemometer in the area, but it is rather far away from the starting zones of Bridal Veil, Lost Creek, and Slide Canyon. Bridal Veil is the most distant, sitting on the opposite side of Provo Canyon 5.5 kilometers to the south. The other disadvantage (when attempting to assess avalanche hazard) is that the summit of Sundance is over 650 meters lower than the starting zones of the slidepaths that threaten the highway.

By mid morning of the 30th I had decided that it was time for action. I requested another helicopter bombing mission for the slidepaths that UDOT bombs (this was delayed until February first when the weather finally allowed flight). At the same time I warned my supervisor of the extreme and increasing avalanche danger now posed by Bridal Veil Falls. He directed me to notify the Utah County Sheriff which I did. During my phone call to the sheriff, I suggested that the sheriff install ava-



Bridal Veil Falls avalanche path



Bridal Veil Falls Closeup

lanche warning signs at Bridal Veil and make a press release to warn the public. I called the Utah Avalanche Forecast Center to suggest that they update their forecast to include an avalanche warning for Bridal Veil Falls and they did. I received a message from the sherriff's office in the afternoon of their plans to put up warning signs on the morning of the 31st.

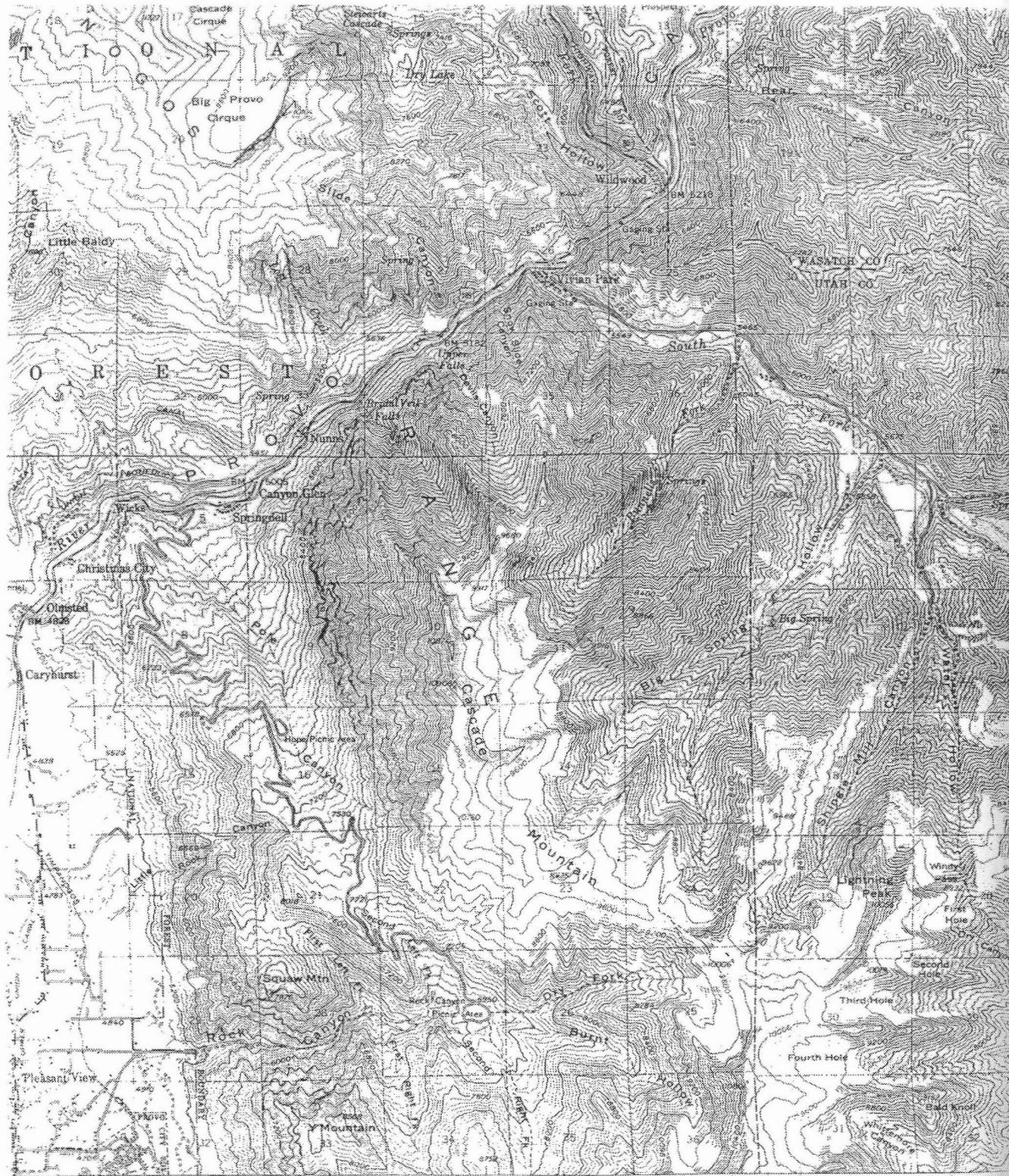
At 1:01 A.M. on January 31, 1996 the Utah Power & Light dispatch office received a complaint of a power outage from the village of Springdell, a community in lower Provo Canyon. The lines that supply power to Springdell are located about 60 meters north of US Highway 189 on the north side of the canyon. On the south side of the canyon the starting zone of Bridal Veil Falls avalanche path is at 3170 meters. On the canyon floor at 1524 meters the Provo River runs next to a two lane county road. As the avalanche crossed the canyon floor, it blew a railroad boxcar into the river, dammed the river with snow, and severely damaged the base terminal of the four passenger tram (used by tourists to view the waterfall in the summer). Another railroad car was blown about fifty meters across the county road and deeply buried under avalanche debris.

This was a dry slab avalanche travelling at very high velocity that was probably preceded by a destructive airblast. After crossing the canyon floor the slide continued up the opposite side of the canyon, and crossed the scenic view parking lot (capacity 52 cars). Still moving at high velocity the avalanche crossed all four lanes of US Highway 189 and continued uphill destroying the power

Precipitation for January 15 through January 31 1996

Date	Olmstead power plant Elevation 4830 feet 1472 meters		Deer Creek power plant Elevation 5300 feet 1615 meters		Snake Creek power plant Elevation 6000 feet 1829 meters		Aspen Grove (UDOT snow study plot) Elevation 6900 feet 2100 meters		Hill's (Sundance Ski Area) Elevation 8000 feet 2438 meters	
	Snow	H2O equivalent	Snow	H2O eq.	Snow	H2O eq.	Snow	H2O eq.	Snow	H2O eq.
	cm.	mm.	cm.	mm.	cm.	mm.	cm.	mm.	cm.	mm.
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	2.5	0	0	trace	trace	0	0
17	25.4	27.2	1.3	55.6	30.5	31.5	25.4	41.1	50.8	82
18	trace	trace	trace	3.8	trace	trace	trace	trace	7.6	3.8
19	7.6	4.6	18	12.7	0	0	33	8.9	35.6	13
20	0	0	7.6	2.5	12.7	10.2	12.7	14.2	12.7	2.8
21	0	0	0	0	0	0	0	0	0	0
22	2.5	1.8	15.2	13.2	12.7	7.4	30.5	16.5	22.9	16.3
23	2.5	0.5	12.7	17.8	trace	0.25	NA	NA	43.2	9.1
24	2.5	1.5	7.6	3.8	7.6	7.6	12.7	6.9	5	10.2
25	7.6	6.35	43.2	15.8	38.1	23.1	45.7	24.1	40.6	16
26	trace	0.25	7.6	1	15.2	17.3	trace	trace	10.2	NA
27	trace	0.8	1.3	0.76	17.8	8.1	5.1	3.6	2.5	1.5
28	trace	0.5	15.2	9.4	10.2	12.2	20.3	14	25.4	17.5
29	trace	trace	0	0	0	0	0	0	0	0
30	15.2	14.7	17.8	12.4	12.7	12.7	25.4	27.2	33	30.2
31	30.5	26.9	17.8	13	10.2	11.7	33	24.1	17.8	10.4
Totals	94	85.1	160	148.3	162.6	142	243.8	180.6	307.3	212.6





SCALE 1:62,500

0 1 2 3 4 MILES

0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 80 FEET
 DOTTED LINES REPRESENT 40-FOOT CONTOURS
 DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION

Heavy duty	—————	Light duty
Medium duty	—————	Unimproved dirt

U.S. Route State Route

This area also covered by 1:24,000 scale maps of Aspen Grove, Impagnago Cave, Over, and Bridal Veil Falls 7.5 minute quadrangles, surveyed



BV US6S Highlight

lines. A section of wall was blown off the tram terminal and across the county road, the parking lot, and the highway to its final resting place thirty meters past the power lines. Trees were broken on the north side of the highway for a width of a 400 meters. Snow was deposited on the uphill side of the highway in a debris pile 550 meters wide with the toe of the deposition 180 meters beyond the highway. The deepest part of the deposition was across the Provo River from the slidepath on the county road. At that point depth was estimated to be 12 to 15 meters. There were no reports of missing persons.

The events described above become less impressive when compared to the fact that the Bridal Veil avalanche was roughly thirty percent of the avalanche that released around 1 A.M. January 31. Fracture propagation along the summit ridge of Cascade mountain connected three separate drainages, Bridal Veil, Bunnell Fork, and Big Springs. In addition to Bridal Veil, this massive slide ran the full width of Bunnell Fork starting at 3322 meters and descending to 1920 meters. Fracture propagation continued hundreds of meters into Big Springs, the drainage south of Bunnells. The crown face that connected these three drainages was over three kilometers wide and averaged between two and three meters deep. The total area involved was approximately 530 hectares. The alpha angle of the Bridal Veil portion of the slide was calculated to be $26^{\circ} 39'$.

At the end of April the buried railroad car was still under avalanche debris. The roof started melting out at the end of June and was halfway melted out by mid August. The avalanche debris on the county road had not melted when this was written and the road was still closed. Several of the conifer trees in the debris were approaching 300 years in age. A conifer from a previous avalanche was over 300 years old.

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UDOT Region Two Avalanche Forecasters

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Photograph Melanie Buck UDOT Media Production Specialist Bridal Veil Falls Avalanche Path

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