SNOW AVALANCHE HAZARD EVALUATION
FOR THE PROPOSED CAMP RAINBOW GOLD
TAX LOT 7995
LOCATED WITHIN SECTIONS 29, 30 & 32, T. 4 N., R.19 E., B.M.,
BLAINE COUNTY, IDAHO

Prepared for
Camp Rainbow Gold

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P.O. Box 2037
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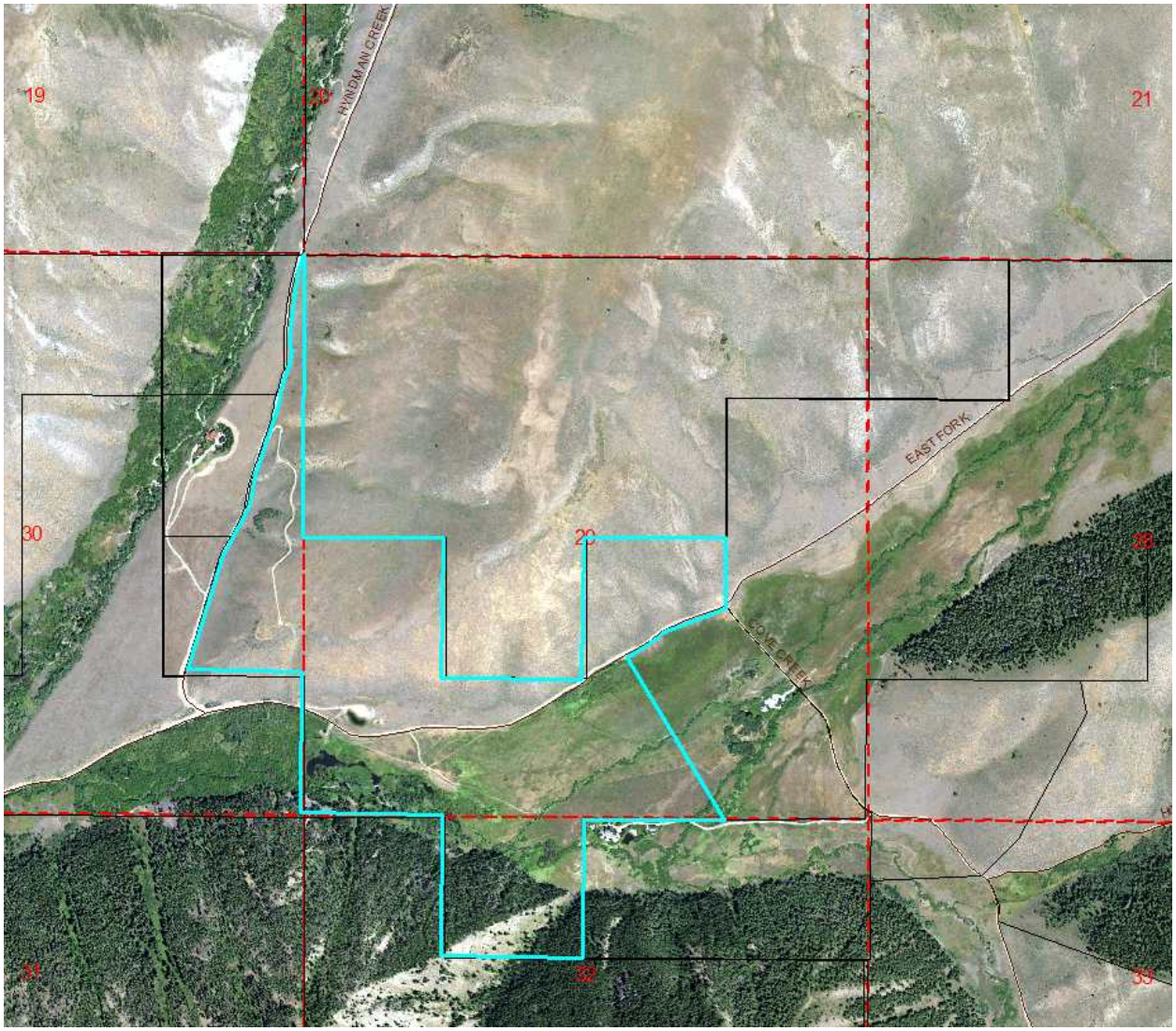
This report will attempt to delineate the potential avalanche danger at the study site by correlating key data, both quantitatively and intuitively, to show runout distances and destructive power within the limits of the avalanche hazard forecasting art. The avalanche hazard areas in this study are considered by Blaine County, Alpine Enterprises, Inc., Camp Rainbow Gold, and their planners to be reasonable for regulatory purposes. However, neither Blaine County, Alpine Enterprises, Inc., Camp Rainbow Gold nor their planners represents, warrants or implies that areas outside of the designated avalanche zones are safe and free from avalanches or avalanche danger. The effects of natural and artificial hazards other than snow are not discussed in this report.



VICINITY MAP – NO SCALE

The intent of this study is to determine the snow avalanche hazard for land use planning and possible winter use purposes. The subject area is commonly known as the Robbins – O'Connor Parcel, in the East Fork of the Big Wood River Drainage, lying within portions of Sections 29, 30 & 32, Township 4 North, Range 19 East, Boise Meridian, Blaine County, Idaho. The geographic position is roughly 43^0 38' 41" North Latitude, and 114^0 13' 26" West Longitude. Elevations range from approximately 6200 feet on the valley floor, to around 7000 feet on top of a ridge that may affect portions of the site. Downtown Ketchum, Idaho lies approximately 7.5 miles northwesterly of the study site. Topographic maps used in the calculations come from the 4' contour LIDAR Data provided by Orion Surveying and U.S.G.S. 7 ½' Series "HYNDMAN PEAK SW" Quadrangle as a GeoPDF.

Field inspections of the site took place in July of 2016.

AVALANCHE CHARACTERISTICS

The following discussion is to help the reader better understand conditions that may lead to an avalanche event. The difference between grade in percent and inclination in degrees should be noted. Percent grade is calculated by the vertical rise divided by the horizontal distance. Inclination in degrees is calculated by taking the arc-tangent of the grade in percent. A four to one slope = 25% = 14^0. Avalanches are generally divided into three areas: a starting zone, a track, and a runout zone. In general, an open slope with an inclination over 27^0 that receives large amounts of snow can be considered a potential starting zone. Once the snow is set in motion, a slope angle of 17^0 is all that is required to keep the snow moving through the track, although 22^0 - 35^0 is a more typical track angle. The runout zone is where the slide starts losing momentum and the debris finally comes to rest. Runouts may begin when the slope angle flattens to 10^0 and some will continue across flats and even uphill.

Avalanches may be grouped into two general types; loose snow, and slabs. These two types may be further subdivided into wet and dry. Loose snow slides occur when individual snow crystals,

due to a lack of cohesiveness, reach their angle of repose and slide down the hill in a generally harmless repositioning, known as a sluff. Wet snow sluffs, although slow moving, may present a hazard due to the sheer mass involved. This type of slide usually occurs in the springtime when factors such as high temperatures, warm winds, rain, and solar radiation create a meltwater saturated snowpack which slides on the ground. Slushflows have been documented on slopes as shallow as 3°, but these are rare occurrences and can generally be disregarded for land planning purposes. On slopes steeper than 50^0, loose snow sluffs occur almost continually during storms, thus preventing accumulations that could become hazardous.

Slab avalanches involve entire layers in the snowpack and have the potential to become extremely dangerous. The most common type of slab avalanche occurs when a large amount of wind deposited snow accumulates on a slope into a cohesive slab, sitting on top of a weaker layer. With an appropriate trigger, this slab layer will fracture into blocks of snow and begin moving rapidly down the hill, picking up momentum and entraining more snow as it propagates. The slide moves on a bed surface, which may be a deeper layer of snow or the ground. Structural instability in the snow pack is due to many factors, some of which are: heavy amounts of snowfall, extreme air temperature changes, a temperature gradient through the layers that forms weak crystals, rainfall, or an ice crust layer.

AVALANCHE ZONING

Blaine County uses roughly the same zoning plan that was developed in Switzerland nearly 60 years ago. The main difference in the two systems is the "return period" factor. Avalanches have been documented for centuries in Europe, while Blaine County still lacks actual records of all occurrences. The best available evidence is talking to long time area users, old newspaper articles, and terrain analysis with personal observations and records.

This report will use the three color (or three zone) system. The three zones are defined as follows:

RED (high hazard) Zone. This area includes terrain where avalanches are expected that have (a) an impact pressure of 30 kPa (600 Lb/Ft^2) or greater with a return period up to 300 years, and/or (b) a return period of 30 years or less regardless of impact pressure. Buildings, roads and winter parking are generally not allowed in the Red Zone (except in the City of Ketchum).

BLUE (low hazard) Zone. This area is the transition zone between high hazard and no hazard zones. Avalanches are expected with impact pressures of less than 30 kPa (600 Lb/Ft^2) and return periods between 30 and 300 years.

WHITE (no hazard) Zone. This area includes terrain with very infrequent small slides and the potential for less than 3 kPa (60 Lb/Ft^2) from the air blast of a large avalanche.

The subject property is affected by all three Zones.

Blaine County Zoning Ordinance 77-5 Ch. 22 - Avalanche Overlay District states in part that:

“No public roads shall be located within high hazard areas and no building permits for residential, commercial or industrial uses will be issued within the high hazard areas, as shown on the Avalanche Overlay maps or site specific avalanche studies.”

"Residential uses are permitted in Low Hazard areas. The following performance standards shall apply to all structures built within the Low Hazard areas:

A. Inhabited structures must be set back from projected slide areas and offset from slide paths.

B. Reinforcing structural modifications shall be incorporated in the design of structures subject to avalanche danger.

C. Natural barriers to potential avalanche slide areas shall not be removed or altered so as to increase the degree of avalanche potential."

It is generally regarded that it is not economically feasible to build wood frame structures capable of withstanding pressures greater than 10 kPa (200 Lb/Ft^2), so reinforced concrete structures may be the most logical direct protection alternative. In some cases avalanche mitigation structures such as catching dams or deflecting berms may be more suitable. Any building that encourages gatherings of people such as schools, churches, and hotels, should not be allowed within Red or Blue Zones.

HISTORY

The East Fork of the Big Wood River drainage has seen man's activities since the late 1800's, but a detailed history of all avalanche activity has not been kept. Interviews with long time area users, old newspaper articles, "The Snowy Torrents", some recent records by the U.S.F.S., and personal observations by this author show the East Fork area, but not necessarily the Study Site to be subject to fairly frequent and often powerful avalanches.

- Circa 1914, 14 miners were killed in an avalanche that destroyed the bunkhouse at the Triumph Mine.
- Circa 1930 a door was blown open by the powder blast near Deckard Gulch.
- In the mid early 1980's I observed an avalanche that crossed and blocked East Fork Road near Thunder Meadows Subdivision. I have also observed several avalanches within Thunder Meadows that have damaged at least 2 residences and crossed Meadowbrook Road.

A former Blaine County Planning and Zoning Administrator recalls a storm in the early 1930's when "it snowed 2 feet, and then rained hard on the new snow, and nearly everything slid." A similar report from the early 1900's reports the same conditions.

All of these scenarios suggest fairly frequent and sometimes powerful avalanche events will continue to occur along East Fork Road. I would suggest that winter travel along East Fork Road could be a greater hazard than occupying safe areas at the Study Site.

SITE ANALYSIS

Please refer to the attached 1" = 200' scale "SNOW AVALANCHE HAZARD MAP" for the following discussion.

The best method for determining avalanche runout distance (which is of primary importance to man and his activities) is a long (300 year) history of past events at the site. If this is not available the next step is to look for damage to trees and other vegetation along the track and runout zone. The generally northerly facing slope lying southerly of the canyon floor is covered with Lodgepole and Douglas Fir which could lend themselves to dendronchronology to determine frequency of past avalanche effects if more precise Return Periods were required. Damage to some of these trees is evidence of past and fairly recent events. In many areas the density of the trees will prevent or tend to mitigate avalanche events. The generally south facing slopes northerly of East Fork Road have very little vegetation to hold snow in place, but these slopes are typically at the lower limits of avalanche terrain except for a few small steep pockets.

The next step is terrain analysis and applying statistical methods developed by mapping hundreds avalanches around the world, and comparing these figures to a local data set to determine runout distance. A few paths were compared with accepted avalanche dynamics models (AVAL-1D) to calculate approximate velocities and impact forces that may be expected.

Blaine County is typically under the influence of Intermountain climatic factors which usually results in a comparatively shallow snowpack and cold temperatures; perfect conditions for creating the usual and expected temperature gradient layers (T. G., kinetic, or "sugar snow") resulting in a weak snowpack structure. This fact coupled with occasional large Pacific storms and the necessary terrain characteristics makes portions of the study site subject to the effects of large, destructive avalanches. The "design avalanches" in this study will be dry snow flowing avalanches, because the impact forces are usually greater than wet snow avalanches, although wet slides could be just as frequent.

During typical winters most of the area will develop a fairly deep snowpack and maintain it due to lack of direct solar exposure. This could be exacerbated by large Pacific storms out of the southwest, leaving up to 2 or 3 feet of new snow. As the front passes, the wind will typically shift to come out of the northwest, and heavily wind load some slopes, resulting in large dry snow avalanches.

Other factors to consider in this area include the effects of creep and glide. Creep is the internal deformation of the snowpack, best described as settlement on an inclined plane. Glide is the slippage of the snow layers with respect to the ground. In areas of deep snow the constant effects of creep and glide can easily move unheated structures, crush vehicles, damage fences, and even bend steel lift towers. The simplest solution to this problem is to maintain an adequate setback (10-15 feet) between inclines and structures.

If fire, insects, or other factors continue to affect the forest health resulting in a less dense tree stand, portions of this area should be restudied to determine if this has affected the avalanche potential. Post fire debris flows could also alter the existing terrain.

LAND PLANNING AND USE RECOMMENDATIONS

In the distant past, there was very little "avalanche hazard" at this site, due to a lack of man and his property. Any additional development and increased use by people will increase the "avalanche hazard" in and around portions of the site. While portions of the proposed Camp will be safe and free from the effects of snow avalanches, other areas should be approached with extreme caution. It is recommended that no structures or winter activity area be placed in Red Zone, and that Red Zones be avoided during winter activities. I would recommend that proposed structures in or very near the Hazard Zones have a site specific avalanche report prepared to ensure that the structure is designed, oriented, and constructed to maximize resistance to the effects of snow avalanches. It must be remembered that persons outside of a protected structure could be at risk, especially if trapped between the avalanche and the structure. Design consideration should be given to avoid, minimize or reinforce any doors, windows, eaves, balconies, chimneys, vents, railings or other protruding parts on areas subject to avalanche impact.

If winter use is planned, the person in responsible charge of the Camp should have at least attended a creditable Level 1 Avalanche Course, regularly consult the weather forecast and check the local Avalanche Hazard Forecast daily. The Weather Channel on TV may be sufficient for weather forecasts, but should be supplemented by checking the NOAA forecast at http://www.wrh.noaa.gov/pih/. The local Avalanche Hazard Forecast can be found at http://www.sawtoothavalanche.com/ or by phone at 622-8027.

If winter activities are planned an Avalanche Rescue Cache should be available on site, remain unlocked, be well marked and visible at all times. The contents should include, at a minimum: 6 sets of probes, 3 shovels, a backboard and blanket, and instructions in case of an emergency. In addition, I would recommend that camp personnel be trained in the use of avalanche transceivers, and use them when performing snow removal and venturing into hazardous areas

for whatever reason.

All visitors including, but not limited to, residents, guests, and emergency service personal should be made aware of the potential hazards, and be allowed to make their own decision on winter travel in this area. If the recommendations in this report are heeded, winter trips during Low, Moderate and Considerable conditions may be considered an acceptable risk, while I feel that during High or Extreme avalanche conditions the overall risk may be too much for uninformed winter guests.

As Pete Schaerer suggests in **The Handbook of Snow**, "the technical work required to identify dangerous zones can be carried out with reasonable accuracy using the procedures outlined above. Determination of acceptable risk and the enforcement of building restriction (and winter use) are political and legal matters."

In conclusion, it is recommended that winter users of this area possess at least a basic knowledge of conditions that may lead to an avalanche event and use this knowledge to protect themselves, other guests, structures and possessions.

Respectfully submitted,

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Alpine Enterprises, Inc.

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