APPENDIX V

1967 REPORT ON THE BEHRENDS AVENUE AVALANCHE PATH

REPORT OF THE PRELIMINARY EVALUATION OF THE BEHRENDS AVENUE AVALANCHE PATH

Conducted for
The City of Juneau, Alaska

Prepared by: Keith Hart
Avalanche Specialist

January, 1967

CONTENTS

P.O. Box 152
Douglas, Alaska

January 27, 1967

The Honorable Lauris Parker, Mayor,
and The Council of the City of Juneau
Juneau, Alaska 99801

Gentlemen:

Submitted herewith is one copy of a confidential study entitled a Report of the Preliminary Evaluation of the Behrends Avenue Avalanche Path. The study was requested by Mayor Parker thru Mr. George Davidson, then Public Works Director, in December 1965, with the very limited field program commencing February 14, 1966.

Due to an unusually heavy workload at my office and combined with some very uncooperative weather, it was impossible to collect snowcover data in the avalanche breakaway zone at two-week intervals as planned. The Field data collected, however, will be of value to any future investigators.

The excellent cooperation and assistance of the Department of Public Works is gratefully acknowledged.

Sincerely yours,

Keith Hart

Keith Hart
Avalanche Specialist

Introduction

At a few minutes past five a.m. on Tuesday, March 22, 1962, a fast-moving, largely airborne dry-snow avalanche slammed into the western part of Juneau's Highland district inflicting varying amounts of damage upon two dozen or more homes. Luckily, because of the hour, only one person was injured. Within a few weeks nearly all signs of the damage were gone: new roofs had been placed on some houses, a number of homes sported patched roofs and siding, a few had new chimneys, and new power and telephone poles replaced those snapped off by the avalanche.

Residents of the affected area had two things to be thankful for: one, and most basic, that they were not killed or seriously injured; and two, that the insurance adjustors chose not to call the avalanche an avalanche. By an exemplary rationalization, the insurance adjustors--under considerable pressure, of course--determined that the damage was caused by "the wind" and not the avalanche. As a consequence, nearly all repairs were covered by the homeowners insurance.

This report will show that the 1962 avalanche was not a freak natural disaster which most likely will never again occur, but that future avalanches should be expected and, most important, to recommend means of eliminating or reducing the hazard to life and property in the affected area.

A normal snowcover consists of a number of distinct strata, each representing one snowfall or snowdrifting period. In the Juneau area, many of the snow strata are separated by ice lenses which are the result of rain, sleet or thaw between snowfalls. As in a chain, the weakest link (i.e., snow stratum) determines the breaking point of the snowcover. If the weakest stratum happens to be at or near ground level, any resulting avalanche may involve the entire snowpack; whereas a weak stratum near the surface will, most likely, involve only that stratum and those above it. It is obvious that if the weak stratum is at or near the ground the degree of hazard is considerably greater than if it is at or near the surface.

On steep slopes much of the newly deposited snow slides during or shortly after falling, thereby reducing the opportunity for avalanches of major proportions. In an ordinary winter--1965-66 was such--there will not be any particularly large avalanches occurring because of these frequent small slides.[1/] This is not to say, however, that there is no danger from these so-called direct-action, surface avalanches. Within this northern temperate, maritime province heavy snowfalls are not uncommon and snowfalls greater than 24 inches occur rather frequently at elevations above 2,000 feet. A 24 inch snowfall in the accumulation zone above Behrends Avenue adds about one-quarter million cubic yards of snow. A not insignificant quantity.

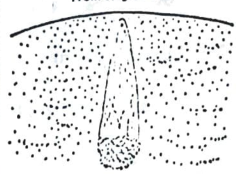
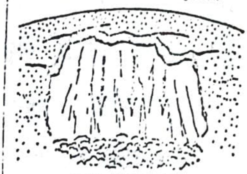
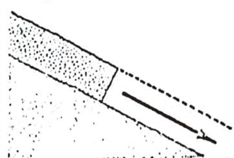
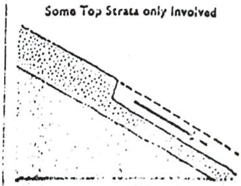
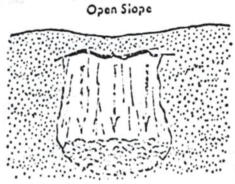
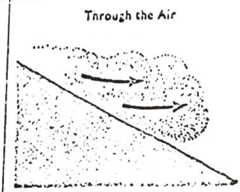
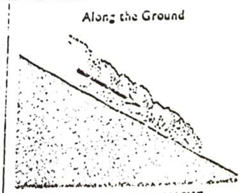
Avalanches are classified by a number of different criteria (Table 1). Most of the larger avalanches in the study area are of the slab type; the

1/ Another factor favoring stability was that there were no weak layers deep in the snowcover during winter 1965-66.

TABLE 1

AVALANCHE CLASSIFICATION SYSTEM

Avalanche Definition: Dislocation of the snow cover over distance greater than 50 metres.

	CRITERION	ALTERNATIVE CHARACTERISTICS AND NOMENCLATURE	
1	TYPE OF BREAKAWAY	From Single Point  LOOSE-SNOW AVALANCHE	From Large Area Leaving Wall  SLAB AVALANCHE
2	POSITION OF SLIDING SURFACE	Whole Snow Cover Involved  FULL DEPTH AVALANCHE	Some Top Strata only Involved  SURFACE AVALANCHE
3	HUMIDITY OF THE SNOW	Dry DRY-SNOW AVALANCHE	Wet WET-SNOW AVALANCHE
4	FORM OF THE TRACK IN CROSS SECTION	Open Slope  UNCONFINED AVALANCHE	In a Gully  CHANNELLED AVALANCHE
5	FORM OF MOVEMENT	Through the Air  AIRBORNE-POWDER AVALANCHE	Along the Ground  FLOWING AVALANCHE

After the system proposed by Prof. R. Haefeli and Dr. M. de Quervain of the Swiss Federal Snow and Avalanche Research Institute in 1955.

March 22, 1962 avalanche was one. The loose-snow type is most common in the spring after rain, warm wind and sun have largely destroyed the cohesive properties of the individual snow crystals through destructive metamorphism. Most avalanches are combinations of the characteristics shown on Table 1 .

The March 22, 1962 avalanche moved down its well-defined path as an airborne-powder avalanche, the form which some regard as the most devastating of all avalanches. Observers in Switzerland have measured the velocity of this type at about 200 miles per hour. It is believed that internal cross-gusts within the slide may move twice as fast as the slide itself. A pressure wave of snow-free air precedes the airborne-powder avalanche. It was this pressure wave or wind-blast that, undoubtedly, did much of the damage in 1962. An avalanche of this type during the same winter but in Switzerland, levelled between 240 and 250 acres of forest and buried one and one-half miles of roadway.

Wet-snow avalances may occur during or following wet-heavy snowfalls, rainstorms or periods of above freezing weather. These avalanches travel at relatively slow speeds; unless of course, they fall free over cliffs. Because wet-snow avalanches move on the ground, they follow natural channels such as stream gullys. Most of the wet-snow slides falling from above the Behrends Avenue area travel down the prominent west to east trending gully (apparent in some of the photographs included in this report).

Avalanches are caused by those factors which reduce the shear strength or increase the shear stress of the snow. Shear strength is reduced by destructive metamorphism of the individual snow crystals through moisture migration toward the crystal nucleus, i.e., the interlocking spikes and branches of the newly

Fallen snow crystals largely disappear. Temperature rise, especially when the snow temperature is near the freezing point, is effective in weakening shear strength. Rain, a warming agent, is an effective destroyer of crystal bonding and in addition, acts as a lubricant. Constructive metamorphism, the formation of cup crystals by moisture migration to the crystal edge, can lead to the formation of deep avalanches since these fragile new crystals commonly occur near ground level. Gradual overloading by snowfall, snowdrifting, or rain is the most common means of increasing shear stress in a snowcover.

In addition to these gradual causative influences, avalanches may be released by external forces or "triggers" such as falling cornices, snowfalls, rocks, animals or humans. In the subject slide area it seems likely that most avalanches are caused by the gradual influences discussed in the preceding paragraph.

For a more thorough discussion of avalanche causes and forms, the reader is referred to the Bibliography and especially to Colin Fraser's, The Avalanche Enigma, Rand McNally & Company, 1966.

Avalanche Defenses

Today there are a variety of defense measures being used to protect life and property from avalanches. These range from simple ordinances to extremely costly snow retention structures. There are two broad concepts of avalanche control: one, the passive, presupposes that avalanches will fall and is, therefore, concerned only with limiting the amount of damage or injury; the other, active control is concerned with the prevention of avalanches.

Land Classification and Zoning - Prior to any construction, known or suspected avalanche areas are investigated by a qualified avalanche specialist. If the land is classified unsafe, it is then zoned by the responsible government to prevent its use for residential and commercial purposes. In certain cases, the hazard may be such that avalanche resistant construction could be used. Governmental regulation of tree cutting in potential avalanche areas is another means of reducing the chances for future avalanches.

Forecasting and Evacuation - In the Alps a number of villages having inadequate structural defenses, rely upon evacuation plans which are based upon hazard forecasting. For example, when a certain depth of new snow falls and when certain other conditions are met, the avalanche forecaster will recommend that persons and livestock within the area move to places of safety. Evacuation is mandatory only in a few villages.

There are at least two serious defects in the evacuation scheme: first, it is always possible that a slide will occur without the benefit of being forecast; and secondly, if the forecaster predicts slides that do not happen—crys "wolf", so to speak--the actual slide will, most likely, catch a number of doubting Thomases. This is not idle conjecture, there are quite a few tragic examples.

Forecasting in the Juneau area is unusually inexact due to the greatly differing conditions between sea level, where the forecaster is, and the avalanche formation or breakaway zone some 2,000 to 3,000 feet above. Here, anyone claiming forecasting reliability above 50 percent is either clairvoyant or given to exaggeration.

Passive Structural Defenses - Included in this category are structures which deflect and arrest avalanches as well as buildings specially built to withstand avalanches.

The road or railroad snowshed is probably the best known example of a deflecting or diverting structure. For obvious reasons it is unsuitable as a defense for residential areas, although the principle is used in the design of some building The deflectors commonly used to protect structures are walls and splitters. The walls or dikes are constructed of earth, sometimes being faced with concrete or stone. The principle of the wall or dike is to channel the moving snow away from the object or objects being defended; this works best when the wall is a continuation of a natural channel., One problem inherent with these defenses is that they will become ineffective once earlier slides have filled the channel. Splitters are designed to cleave or split the descending avalanche around the defended object. Splitters vary from simple earthen mounds to elaborate wedges shaped much as the prow of a ship.

Arresting defenses perform best when located on transitional grades where slide velocity is being reduced naturally. Arresters include dams, terraces and breakers. Dams are generally built across channelized slide paths, the idea being to catch as much of the slide as possible. Few dams can be built large enough to contain one season's avalanches. Wide terraces are sometimes useful in checking or containing slides, but, generally, have little effect against large, fast moving avalanches. The most effective of the arresting structures are the so-called avalanche breakers, consisting of two, three or more rows of 15 to 20-foot high earthen mounds. The mounds are so spaced that an avalanche striking them is broken or divided into a number of small currents which are then directed against each other.

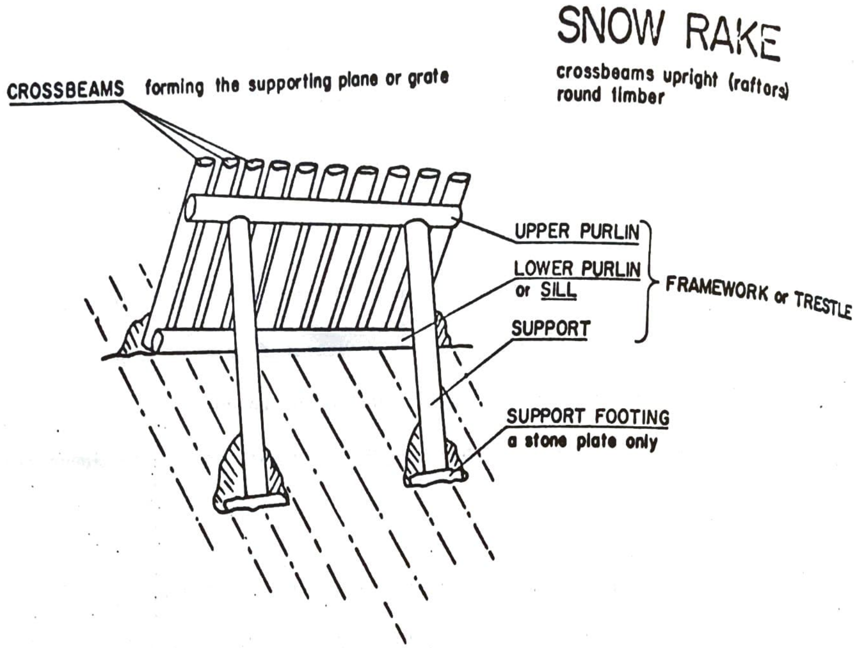
Buildings in slide areas (e.g., mines, power and communication stations, etc.) are often constructed to withstand avalanches. Measures used include the shed roof, reinforced concrete or masonry upslope walls and no openings in upslope walls. In addition, there may be a splitting mound or diversion dike above the building.

All of the passive defense structures discussed, except for the snowshed, are subject to avalanching which may exceed their capabilities. Early season slides can fill channels, cover dams, walls and dikes or load breaker systems and thus pave the way for later slides to travel unimpeded. None of these structures, snowsheds excepted, offer adequate protection against high-velocity, airborne-powder avalanches.

Active Structural Defenses - Snow retention in the breakaway zone is accomplished by means of fence-like structures, nets and reafforestation. Wind baffles are used to prevent the formation of stress-susceptible snowslab, while snow-drift fences reduce deposition in the breakaway zone.

Evolution of snow retention structures has followed this pattern: 1) earth terraces; 2) earth terraces and dry masonry walls; 3) wooden fences; and presently 4) lightweight metal barriers and steel or nylon nets. Because of the continually rising cost of manual labor, metal barriers and nets are now favored. (see Tables 2 & 3)

TABLE 2


SNOW RAKE
crossbeams upright (rafters)
round timber
CROSSBEAMS forming the supporting plane or grate
UPPER PURLIN
LOWER PURLIN
or SILL
SUPPORT
FRAMEWORK or TRESTLE
SUPPORT FOOTING
a stone plate only

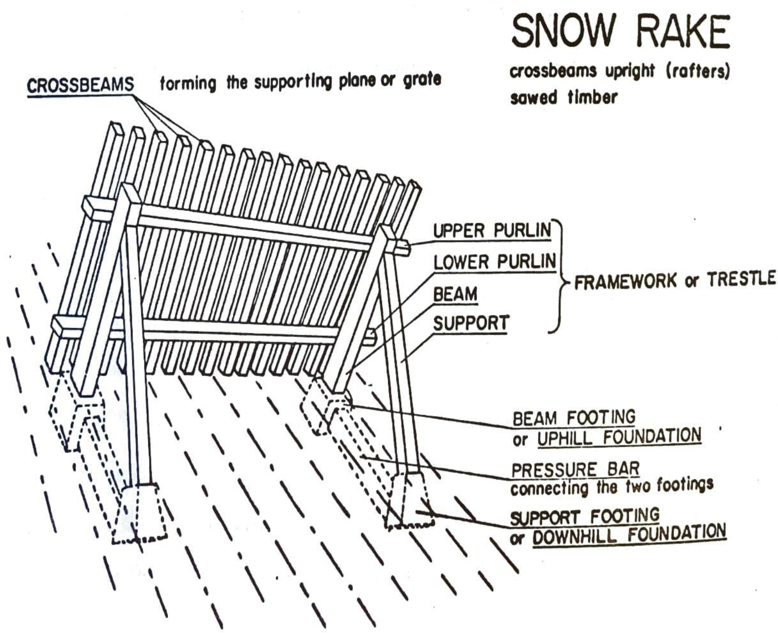
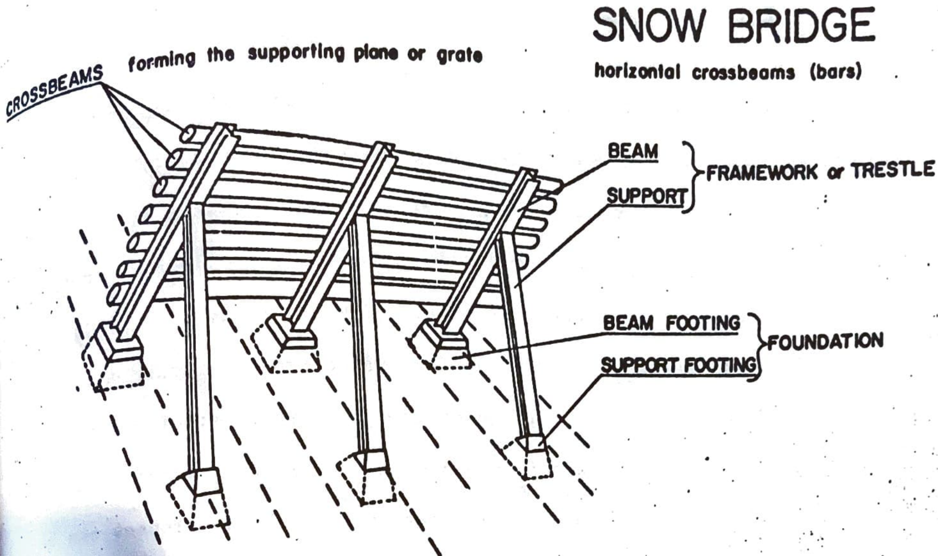
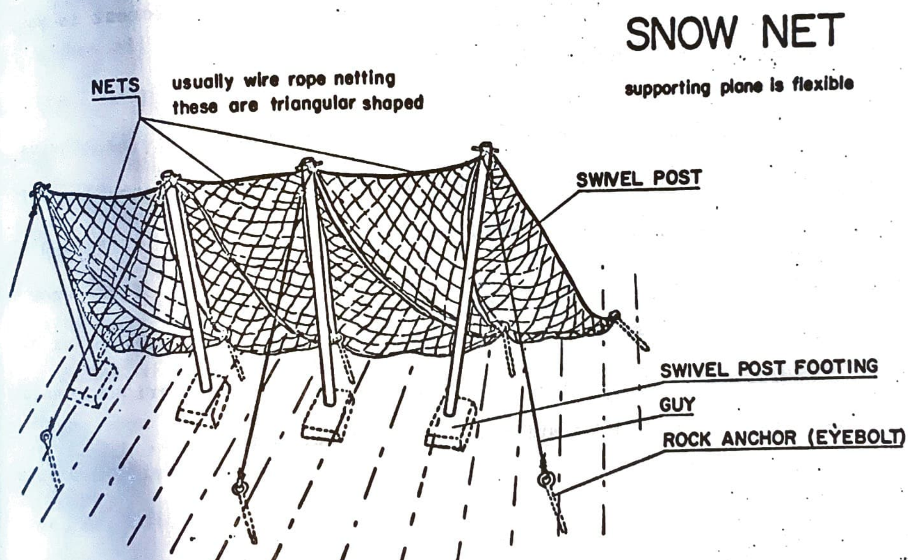

SNOW RAKE
crossbeams upright (rafters)
sawed timber
CROSSBEAMS forming the supporting plane or grate
UPPER PURLIN
LOWER PURLIN
BEAM
SUPPORT
FRAMEWORK or TRESTLE
BEAM FOOTING
or UPHILL FOUNDATION
PRESSURE BAR
connecting the two footings
SUPPORT FOOTING
or DOWNHILL FOUNDATION

TABLE 3


SNOW BRIDGE
horizontal crossbeams (bars)
CROSSBEAMS forming the supporting plane or grate
BEAM
SUPPORT
FRAMEWORK or TRESTLE
BEAM FOOTING
SUPPORT FOOTING
FOUNDATION


SNOW NET
supporting plane is flexible
NETS usually wire rope netting
these are triangular shaped
SWIVEL POST
SWIVEL POST FOOTING
GUY
ROCK ANCHOR (EYEBOLT)

The purpose of barriers and nets is to prevent the formation of potentially destructive avalanches by interrupting and holding the snowcover. These barriers, called bridges if the crossbeams are horizontal or rakes if the crossbeams are upright, and nets are very costly. The installed, per meter costs in Switzerland are: aluminum bridge - $255; and steel cable net - $135. In certain slide paths many hundred meters of structure may be required to provide the necessary control. Very rough estimates of the cost of these defenses installed in the subject area are from 3-5 million dollars. A thorough study of snowcover, and soil conditions is necessary before these defenses can be designed and installed. Wherever possible reafforestation is accomplished shortly after the barriers have been installed, since a dense forest is regarded as the most permanent defense possible.

Other measures for limiting the build-up of avalanches include: 1) the use of wind baffles to disrupt the snowcover-- prevent slab formation; 2) drift fences to prevent overloading and slab formation; 3) chemical inhibition of depth hoar (cup crystal) formation*; 4) mechanical compaction of the snow by skiers, walkers or machines; and 5) the premature release of avalanches by skiers or explosives. Only items 1) and 2) appear to merit serious consideration as possible defense measures for the subject slide area.

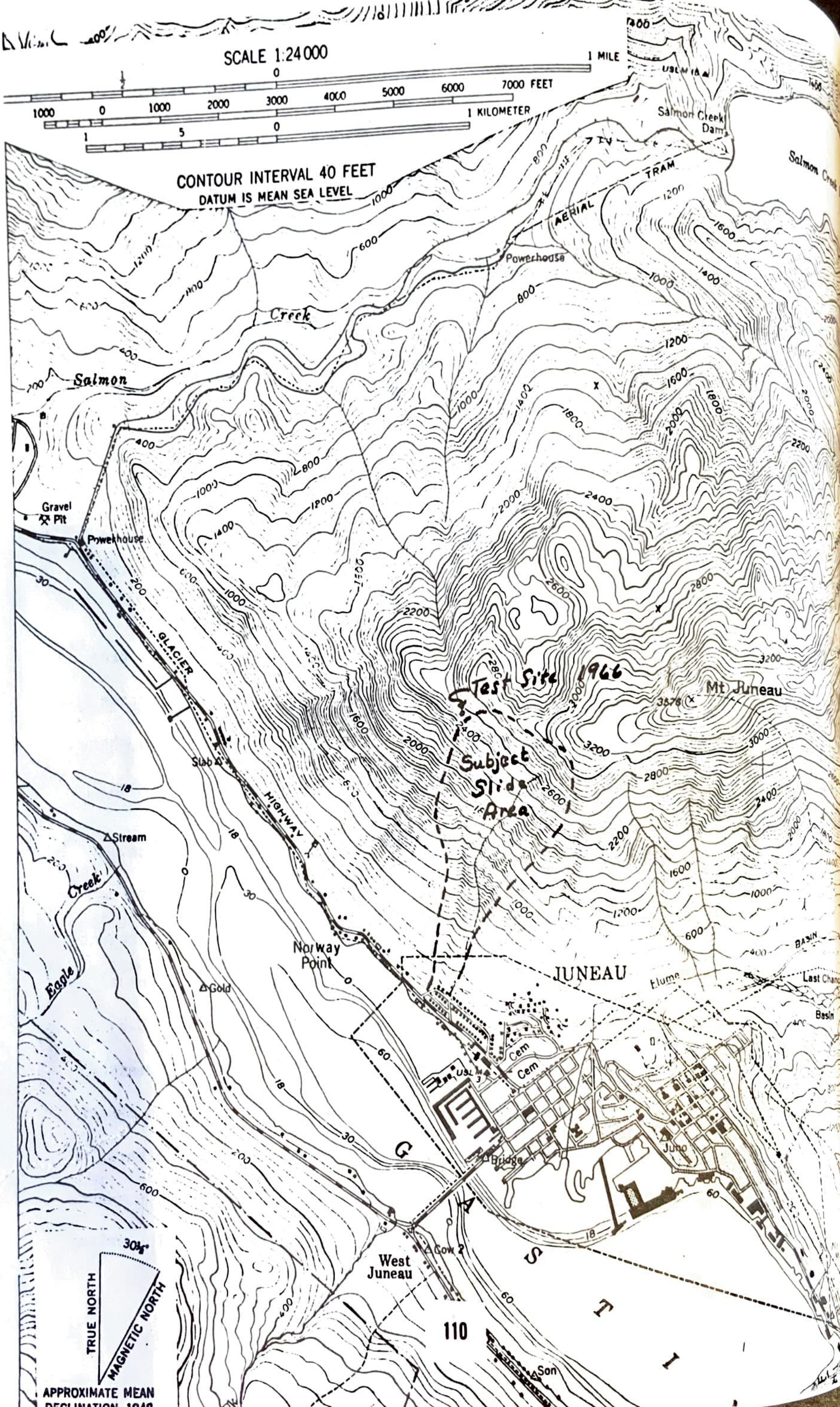
* Still in the experimental stage.

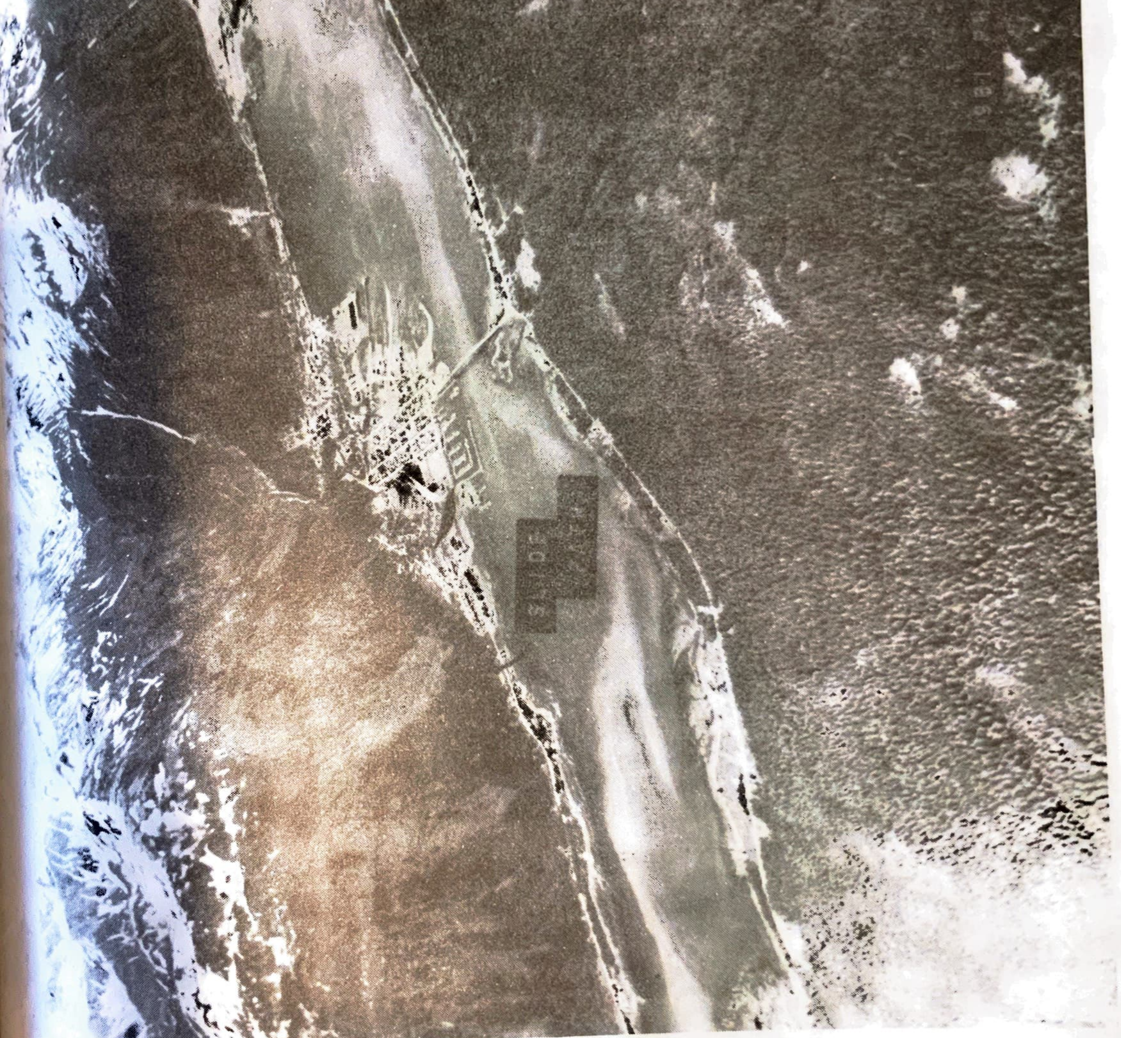
The Behrends Avenue Avalanche Path

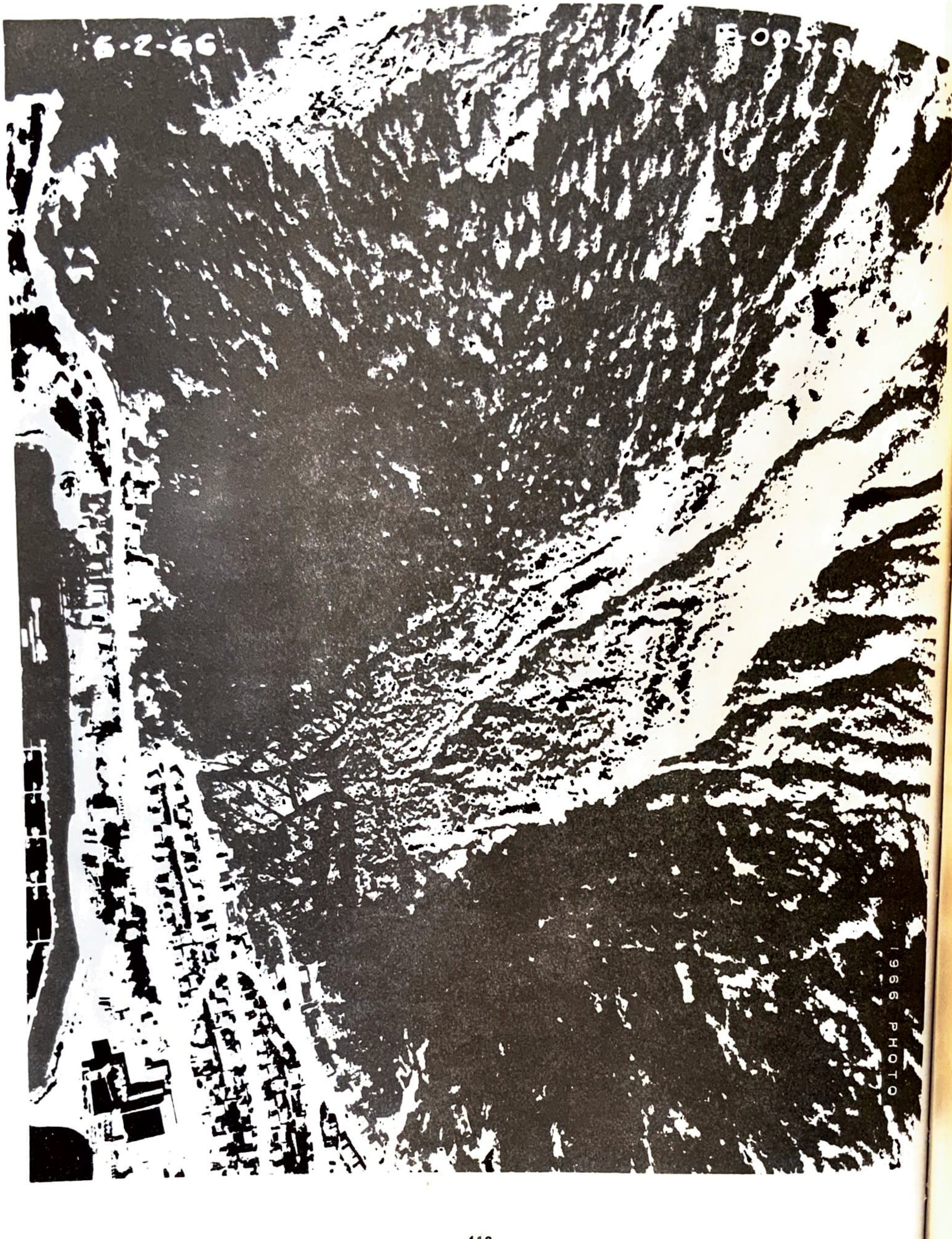
Certainly one of the strongest impressions received by the first-time visitor to Juneau is that of dynamic nature -- rushing streams, rugged glaciers, dense forests and mountains plunging abruptly to the water. Shortly following this overview, he begins to notice the violently irregular forest pattern on the mountain slopes. If he happens to be an avalanche specialist, he knows that it is an area subject to frequent, very large snowslides. (see photos, particularly 1961 oblique aerial)

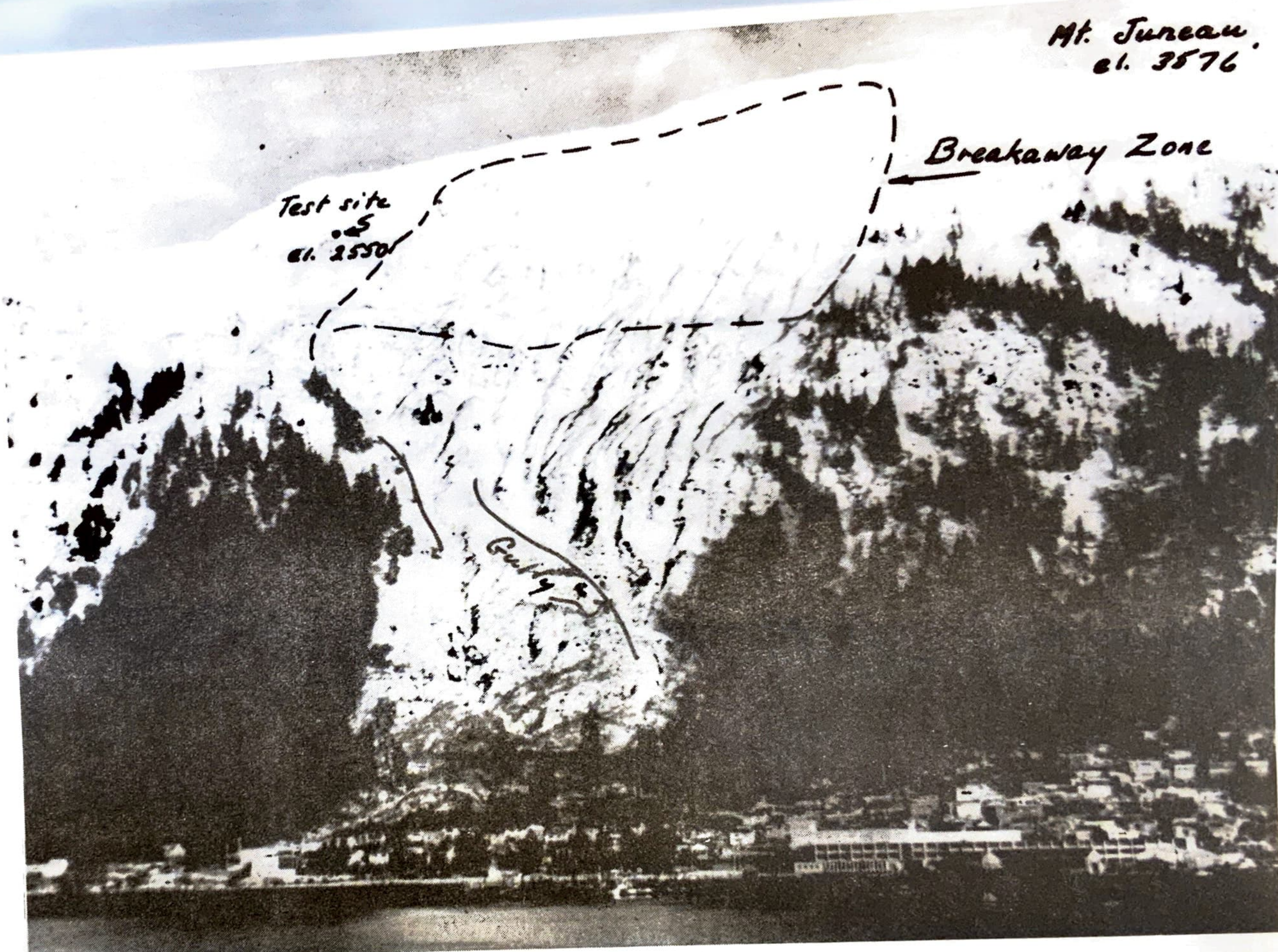
An avalanche track in a forest can reveal a number of important clues. First, the limits, both lateral and terminal are indicated -- this is no assurance, however, that later slides will not enlarge the clearing. Second, if the trees are broken off some distance above the ground, an airborne-powder avalanche was the likely villain. Third, if the broken trees are sizable, it was probably a fairly long-cycle avalanche. And last, if alder, grass and berries are the primary vegetation in the slide swath, it is reasonably certain that avalanches occur frequently even though they do not often reach the timber.

The Behrends Avenue Avalanche path exhibits all of these characteristics. (see photos of 1962 slide damage). In addition, a number of the scientists who have been associated with the continuing Juneau Icefield Research Project have identified the Behrends Avenue area as a major avalanche path. One of these, Mr. Edward LaChapelle, now avalanche Hazard Forecaster for the U.S. Forest Service and regarded as the leading U.S. avalanche authority **remarked** in a recent letter to the writer: "...that this was a possible avalanche danger zone was known all along by a number of people in Juneau. I, among others, pointed this out to Forest Service officials more than ten years ago, but some of the local residents were already aware of the fact, even then." The writer

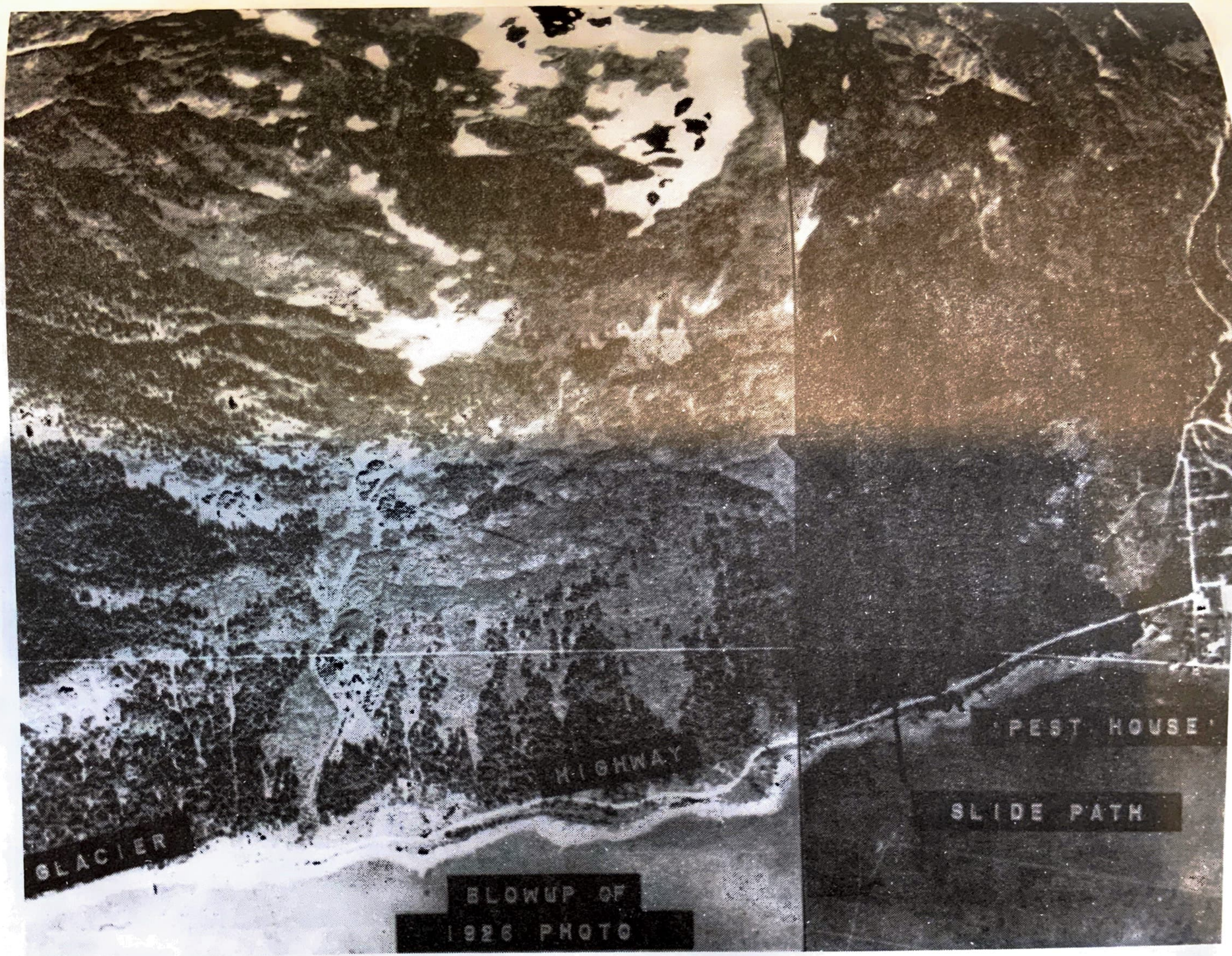

SCALE 1:24000
1 MILE
7000 FEET
1 KILOMETER
CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL
Salmon Creek Dam
AERIAL TRAM
Powerhouse
Salmon Creek
Gravel Pit
Powerhouse
GLACIER HIGHWAY
Slab
Stream
Eagle Creek
Gold
Norway Point
Test Site 1966
Subject Slide Area
Mt Juneau
JUNEAU
Flume
Basin
Last Chance Basin
Cem
Bridge
Juno
G A S T I
West Juneau
Cow 2
Son
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1948



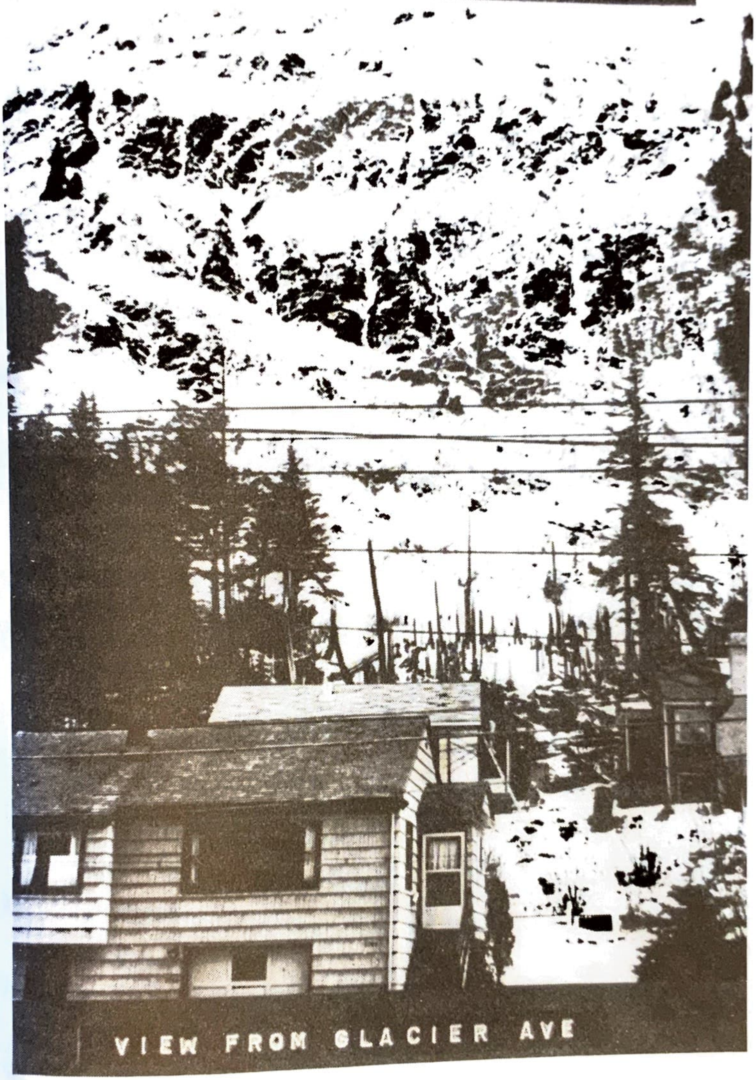

6-2-66
1966 PHOTO



Mt. Juneau
el. 3576
Breakaway Zone
Test site
S
el. 2550
Gully

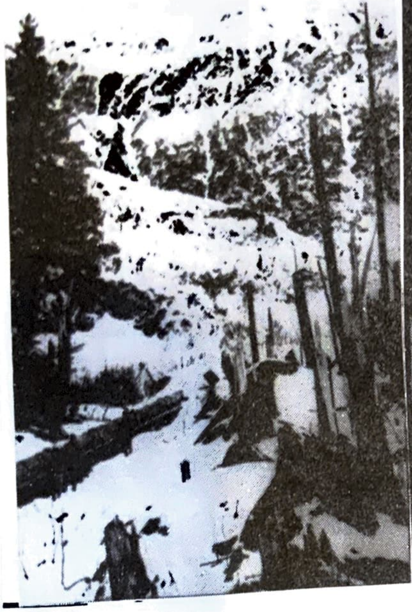

PEST HOUSE
SLIDE PATH
HIGHWAY
GLACIER
BLOWUP OF
1926 PHOTO

SHORTLY AFTER 1962 AVALANCHE



VIEW FROM GLACIER AVE

1962 AVALANCHE



has also been advised that the avalanche potential of the area was discussed when the area--with houses already built--was being annexed by the City of Juneau.

By means of interviews a rough history of the subject slide path has been developed back to the year 1890. In reading this brief chronology, the reader should bear in mind that prior to about 1946 the only structure in the slide path above Glacier Highway (now Avenue) was the so-called "pest house" a long abandoned, World War I vintage, smallpox isolation building. This is on important consideration because there could have been, and likely were, avalanches which did not reach the highway and therefore were unobserved. A brief history of the observed avalanches follows.

1890 - This was an extremely large avalanche which terminated in Gastineau Channel, where the Aurora Basin small boat harbor is now located. The late Mr. Gene Nelson, manager of the A-J Corporation's Juneau facilities, possessed a photograph of the avalanche. Information from Mr. W.S. Twenhofel, Geologist, U.S. Geological Survey, Denver, Colorado.

1917 - This was a very large avalanche which crossed the road (then little more than a trail) and ended just short of the shoreline. A great number of trees were destroyed; the broken trees prevented the early reopening of the road which was used by a dairyman. The slide probably fell in March or April; it was believed to have been an airborne-powder type. Information from Captain L.H. Bayer, then a school child living at Norway Point. Also recalled by Mr. George Skuse.

1926 - This was a large avalanche that flowed around the old "pest house." From descriptions given, it is believed that it was a wet snow avalanche, a type which moves on the ground. It probably occurred in late March or April.

Information supplied by Mr. Joseph McLean and Mr. Robert Killewich. Mr. Killewich recalled that one part of it reached tidewater. From the type of slide, it can be inferred that the part reaching tidewater probably traveled down the stream gulley which now intercepts Ross Way.

1935 - There is not much information available regarding this avalanche which was reported by Mr. George Danner. It did, however, cross the highway.

1946 - This was the last sizable avalanche reported in the Behrends Avenue area prior to the one in 1962. Mr. R.E. (Randy) Randall observed that this avalanche terminated in the trees above the old shop building at 1735 Glacier Avenue. The slide reached at least as far downslope as Behrends Avenue. It probably was a wet snow type with motion confined to the ground and of such low velocity that it flowed around the trees without breaking them.

1962 - This avalanche is well documented. According to Mr. R.E. (Randy) Randall who was possibly the only eye-witness, the airborne-powder avalanche travelled completely across Gastineau Channel terminating near the Treadwell Ditch at elevation 750 feet. As some of the photos show, the avalanche destroyed some 10 acres of spruce-hemlock timber, some of the individual trees as large as 18 inches in diameter. Branches, limbs and parts of tree trunks were hurled into tidewater at the location of the new Aurora Basin small boat Harbor. Damage to the houses included: removal of roofs; collapsed walls; buildings off foundations; chimneys broken off, and windows broken out. A few 60 pound chimney blocks were blown 135 feet onto houses fronting on Glacier Avenue. Damage estimates ranged from a high of $250,000* to a low of $150,000; the true figure, no doubt, lies somewhere between.

* Newspaper article: The Alaska Empire, Juneau, Alaska, March 22, 1962

The Juneau newspaper reported the following damage: F.G. Nottingham house (229 Behrends) knocked from foundation and one wall torn out; Harvey Willson house (226 Behrends), back window blown out and 18 inch diameter tree "...tossed across roof.;" J.A. Herdlick house (245 Behrends), "Roof ... completely gone." and windows facing mountain blown out; Cecil Willis house (241 Behrends), roof off and windows facing mountain blown out; and W.W. Hackwood house (1736 Glacier Avenue), "...had a large hole in the roof caused apparently by a tree hitting it." From the same newspaper: "The full force of the avalanche caused wind seemed to hit the Highlands area between Ross Way on the North and about 221 Behrends, although traces of heavy snow and scattered tree branches were farther south on Behrends."

Future Avalanches - Unless Juneau's climate becomes tropical or sub-tropical, it seems reasonable to expect future avalanches. In the 76 years covered by this report, there have been at least six large avalanches reported in the Behrends Avenue area, or if averaged one about each 13 years. Unfortunately, however, avalanches--especially long-cycle--do not wait for the "count of three" to begin shooting. Between 1890 and 1917, 27 years passed between slides. The next avalanches, 1926 and 1935, occurred nine years apart; the 1946 avalanche 11 years later; while the 1962 avalanche waited 16 years.

The writer will not hazard a guess (and that is all that it would be) as to when the next avalanche will fall; but given the past history of the area and the long-term climatological forecasts which say that colder winters are in the offing, the possiblity of destructive avalanches seems real.

Some Possible Defense Measures for the Behrends Avenue Area

The following are possible courses of action to be followed for reducing the hazard to persons and property in the affected area.

1) The area indicated on the City Map and Photomap would be declared a high hazard area. All homeowners and others having an interest (e.g., tenants, mortgage holders, insurance companies) would be so advised. Sellers would be required to advise prospective buyers of the hazard classification; failure to do so would be a criminal offense. No further construction would be allowed in area if purpose of construction is to house additional persons. In case of destruction of existing house, no replacement would be allowed.

2) Establish an avalanche forecasting service and prepare an evacuation plan. Evacuation to be mandatory or optional?

3) Require that walls of houses facing avalanche be reconstructed of reinforced concrete, braced and without openings or else require that a separate reinforced concrete deflection wall be built a few feet from each house. Establish standards for these constructions.

4) Construct avalanche breakers and diversion dikes at base of slope and above houses. Reafforest.

5) Construct snow retention devices in the formation and breakaway zone.

6) Require removal of all houses in affected area. Rezone land for summer recreational use.

Course of action 6) is the only one which would completely eliminate the hazard. Course of action 5) in conjunction with 4) and 3) would probably reduce the hazard to tolerable levels. Courses of action 1) and 2) together should be regarded as the minimum level of effort. While no definite cost estimates are available, it appears reasonable to guesstimate that course 6) might cost 250,000 to 350,000 dollars whereas courses 4) and 5) combined may run to as much as five million dollars.

It is rather obvious that any of these courses of action will raise financial, legal, political and moral questions (and not necessarily in that order). However, to do nothing may lead to consequences too terrible to contemplate.

Conclusion and Recommendations

There is every reason to expect future major avalanches in the Behrends Avenue area. In order that tragedy will be averted, the following recommendations are made.

1) That as a first step the area within the lines on the enclosed City Map and Photomap (1) be declared a high hazard area; (2) be publicized as such; and (3) be zoned to prevent further construction, and reconstruction if damage[1/] repairs amount to 50 percent or more of the value of the structure.

2) That an avalanche hazard forecasting service and evacuation plan be established.

3) That an engineering study be conducted by some qualified individual or organization to determine the cost of a structural defense system. The writer recommends consideration of the Federal Institute for Snow and Avalanche Research,

   Weissflujoch/DAVOS, Switzerland
   (Dr. Marcel de Quervain, Director)

4) That a study be made to determine where the buildings can be relocated and the cost of relocation.

5) That a study be made for financing the recommended measures.

6) And based upon the results of the studies recommended above, 3), 4) and 5), that either a structural defense system be constructed or the houses be removed

7) Additionally, it is recommended that the City of Juneau through the Greater Juneau Borough, strive to prevent the use of avalanche susceptible land for building sites in areas likely to be annexed by the City.

1/ Damage from any cause.

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APPENDIX A

Avalanche Forecasting - A Modern Synthesis

E. LaChapelle
United States Forest Service

ABSTRACT

Avalanches are generated by structural weaknesses in the snow cover. Some of these weaknesses can be observed and measured by investigating snow stratigraphy in pits or with instruments. This method offers reliable data from direct observation, but it is time-consuming. It is most effective when forecasting climax avalanches caused by snow metamorphism or a sequence of snowfalls.

Many avalanches fall during or immediately after a single storm. Time usually does not permit stratigraphic investigation, which is difficult in fresh snow. These direct-action avalanches can be forecast by an analysis of meteorlogical factors prevailing during the period of snow deposition. This indirect evidence is less reliable, but can be more easily obtained and often is the only forecasting guide available.

The accuracy of such forecasts is checked by practical field tests for the existence of tensile stresses leading to slab avalanche formation. Tests are made by disrupting the snow in potential slab zones with skis, with explosives, or with artillery fire, according to the character of the snow and accessibility of the test zone.

In practice, these methods are combined, weight being given to one or another according to circumstances largely determined by climate. This determination is illustrated by examples from different climate zones in the western United States.

Definition of Terms

Avalanche forecast-------------	Either an evaluation of current avalanche conditions or a prognostication of future ones, the latter depending on mountain weather forecasts.
Climax avalanche---------------	This type falls as the result of internal structural weaknesses within the snow cover which may develop over long periods of time. It may be triggered by a new snow fall, but involves snow layers at the release point deposited by more than one storm.
Direct-action avalanche--------	This type falls during or within 24 hours after a storm, and involves only the snow of that storm at the release point.
Hard slab----------------------	The constituent snow of a slab avalanche with a high degree of internal cohesion. Sliding snow usually remains in chunks or blocks.
Soft slab----------------------	The constituent snow of a slab avalanche with a low degree of internal cohesion. The sliding sonw breaks up into an amorphous mass and may resemble loose snow.