AN EVALUATION OF AVALANCHE HAZARDS TO SUBDIVISIONS NO. 1, 2 AND 3 OF THE YODELIN DEVELOPMENT, STEVENS PASS, WASHINGTON

Prepared for Mel Borgersen and Associates

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An Evaluation of Avalanches Hazards to Subdivisions No. 1, 2 and 3 of the Yodelin Development, Stevens Pass, Washington

This report deals with the exposure to possible avalanche danger of the lots located in Subdivisions 1, 2 and 3 of the Yodelin development on the east side of Stevens Pass. It is based on the results of an on-site inspection of all three subdivisions made on 13 July 1971. Present with me at this inspection were Mel Borgerson, Len Miller and Wendell Carlson.

Evaluation of avalanche danger has been based on historical records from this area (see Resort Counselling Associates report to Robertson Timber Co. of 1966, and my informal report to the Washington State Department of Licenses of 1968), on an examination of the effects of the large avalanches which fell in January of 1971, and on an estimate of avalanche behavior based on inspection of terrain and vegetation patterns in the area.

A substantial number of the lots designated on the present plats for the three subdivisions lie within active avalanche zones and should not be considered suitable sites for private residences. A small number of lots are marginally exposed to avalanche danger and may be considered for use as residential sites if the property owners are willing to accept a small calculated risk of avalanche damage. In this case certain structural features are recommended for the buildings on these sites to minimize such damage. The remaining lots appear to be largely free of avalanche danger.

Individual lots are discussed below for each subdivision. Lot identification is based on the current plats for the Yodelin area. Particular attention is given to the existing buildings on these lots.

Subdivision No. 1 -

This subdivision lies along Stevens Creek at the foot of the steep, east-facing slopes falling from Point 5322 (U.S.G.S. Labyrinth Mtn, 7.5' Quadrangle map). These slopes are swept by frequent small and occasional large avalanches. A shallow gulley above the south end of the subdivision provides the most serious avalanche danger, but avalanches also occur all along the open slopes north of this gulley. Large avalanches falling from Point 5322 have been reported on at least one occasion (1957 or 58) to run as far as Stevens Creek, clear across the subdivision, and on another occasion (1948) ascended the opposite slope onto the highway (U.S. 2). Evidence of vegetation damage confirms such reports and indicates that the avalanches from Point 5322 which fell in 1971 are by no means the largest which have occurred here.

Lot A, Lots 1 through 26 inclusive, and Lots 55 through 71 inclusive are exposed to the avalanche activity described above and should be considered unsuitable building sites for residences. Of the existing houses on these lots, only the two on Lots A and 1 (Carlson, Macpherson) are favorable situated for protection by an avalanche diversion barrier or mound. These two houses are located sufficiently far from the toe of the steep slope falling from Point 5322 that diversion of flowing snow might reasonably be affected. The gulley mentioned above discharges avalanches in the direction of these houses, but these must first cross a shallow bench between the gulley mouth and the houses. A large mound on this bench would probably offer a substantial amount of protection to Lots A and 1. Such a barrier would not guarantee 100% protection.

The existing houses in the zone of lots 2 through 26 are all severely exposed to avalanche hazard. Except for the McLaughlin-Mitchell house on Lot 8, all are poorly constructed to resist sliding snow. The heavy log construction of the house on Lot 8 offers some resistance to small avalanches, but cannot be expected to withstand large ones. This house is in an especially

vulnerable position next to the gulley. The Johansen and Stone houses (Lots 21 and 22) were both damaged by avalanches in January 1971. The Edger house on Lot 23 was completely destroyed by an avalanche at this time. In evaluating the hazard along the foot of this slope, account is taken of the fact that the avalanche which destroyed the Edger house so completely is reported to have originated at a fracture line just below the old railroad grade (report by W. Carlson). Even in this short fall distance a large and very destructive avalanche was generated. Most of the avalanches originating on these slopes start higher up and fall farther. The existing houses on lots 55 through 71 are also exposed to avalanche activity. These lots are located across the road from lots 2 through 26 and consequently are farther away from the toe of the steep slope. This location does not offer any substantial increase in safety; large avalanches falling from the slopes above can readily cross the road and reach this area. There is, of course, less possibility of the smaller avalanches crossing the road to reach these lots, but any reasonable assessment of the hazard in this area cannot be confined solely to the behavior of the small avalanches.

Because of the frequency of avalanches which fall from Point 5322 I recommend that further development on the endangered lots described above in Subdivision No. 1 be discouraged and that the present existing houses be moved to safer locations. Other than the two houses mentioned on lots A and 1, the existing houses in the endangered area of Subdivision No. 1 do not appear to be suitably located for protection by mounds. An earth fill mound is an avalanche diversion barrier. It works most satisfactorily on relatively low angle of slope and for protecting isolated structures. If a whole row of houses have to be protected from avalanches then the use of mounds becomes ineffective because there is nowhere to divert the avalanche.

snow diverted from one house simply becomes a threat to another one. In any case, mounds to protect the houses on the lots downslope from the road (lots 55 through 71) in order to be effective would have to be located in the middle of the road. These mounds would have to be large, preferably with a height of the same order as the heights of the roof peaks on the houses. The houses presently located on the uphill side of the road (lots 2 through 26) are at the toe of the steep slope and do not have enough space available behind them for the effective use of earth filled mounds. In this latter location masonry diversion wedges would be the only suitable type of defense, but the close spacing of the houses raises the same problem of where to divert the flowing snow. Protection for buildings on the uphill side of the road might also be achieved by in constructing such buildings into the slope with a heavy avalanche roof in the form of a snow sled over the top. This could hardly be applicable to the present buildings, which would have to be completely rebuilt to fit this type of defense.

Particularly in respect to Subdivision No. 1, but also applicable to the other two subdivisions, is the basic concept that recreation homes in such an area as Yodelin should depend on avalanche barriers, wedges, mounds or sheds as protection only in those cases where the owners plan to use them as summer residences. I do not recommend adoption of expensive defense protections in such areas as these for use to protect regularly occupied winter residences. The existence of defense measures for the buildings does not offer any protection for the normal traffic and use of pedestrians and vehicles in this area. It may be argued that the residents who presently own homes in the endangered areas could protect them by barriers, however

complicated or expensive these might be, and then adjust their patterns of winter use to minimize the exposure to avalanche danger. The key considering, though, is that when we plan the design, layout and use of an alpine recreation area such as Yodelin, we must plan for future, unforseen and very probably rapidly increasing use. It would be unwise to place confidence in a scheme of area use based on present day occupancy, character of the residents or general recreational use in the Stevens Pass area.

In summary it is important to minimize near and distant future problems now by wise planning and reasonable precautions rather than to take barely adequate measures to meet the present hazard and find the problem of avalanche threats to the subdivision rebuilding at a later date. I firmly recommend that the houses exposed to avalanche hazard in Subdivision 1 be removed to safer locations.

In addition to the question of the lots and houses discussed here, there exists the question of the two water reservoir tanks located on slopes which are exposed to avalanche activity. These two tanks provide culinary water for all the Yodelin subdivisions and should be protected against avalanche damage. Both tanks are stoutly constructed of steel and firmly anchored to concrete. They probably would resist the force of small avalanches but equally probably they would not resist the force of large ones. Adequate protection for both tanks at modest cost can be achieved by the construction of diversion wedges immediately above the tanks and these wedges should be at least as high above the ground as the tanks.

If the present property owners in the exposed areas of Subdivision No. 1 should choose to protect their existing houses with barriers instead of removing them to a safer site, then I strongly recommend that the services of a competent avalanche defense structures engineer be sought for the design of these defenses.

Subdivision No. 2

Subdivision No. 2 lies along the south side of Nason Creek and at the foot of the steep north slope falling from the end of the ridge and point 5322. The principal avalanche danger to Subdivision No. 2 is from the frequent avalanches which fall from this north slope. This subdivision is divided by an east-west access road along the crest of a shallow ridge between Nason Creek and a small unnamed drainage lying immediately at the foot of the north slope. Those lots which lie to the north of this access road appear to be free of avalanche danger from the north slope except possibly in the most extreme circumstances when a dry snow avalanche with dust cloud might pass across the road and induce wind blast damage. The existing houses north of the access road to subdivision number 2 appear to be reasonably well located to avoid exposure to this possibility. Future construction in this area should preferably keep the house profiles low and where possible below the crest of the ridge. High structures located on the ridge crest immediately adjacent to the access road would be the most vulnerable in the event of such a wind blast.

On the south side of the access road on the opposite side of the shallow ridge the degree of exposure to avalanche danger increases toward the west. The avalanche activity from the gulleys on the north slope appears to increase both in magnitude and frequency toward the west and the intervening shallow gulley between the toe of these avalanche slopes and the lots to the south of the access road becomes more shallow toward the west. Lots 1 through 11 inclusive are directly exposed to possible overrun by sliding snow falling from the north slope of point 5322 and cannot be considered suitable as sites for the construction of residential housing. East of Lot 11 there are no more major chutes falling from the north slope. The slope itself becomes

shorter and the intervening gulley deeper. Lots 12 through 19 inclusive thus are exposed to substantially less avalanche danger than are lots 1 through 11. There is still some likelihood of flowing avalanche snow reaching these latter lots but this chance is reasonably small. By the assumption of a small calculated risk of damage it might be possible to construct houses on lots 12 through 19. In order to minimize this calculated risk these houses should be built only adjacent to the access road on masonry or earth-filled foundations which would raise them to the level of the road. These houses should have their walls facing the north slope free of large windows and constructed with sufficient strength to resist the impact of wind blast and possibly a light impact from flowing snow. One house presently exists on a lot among this group but does not meet the criterion for a safe type of construction because it rests on a very light foundation structure of wood which extends close enough to the bottom of the gulley to be exposed to incursions of avalanche snow. The south facing wall and windows are also unsuitable.

From lot 20 through lot 25 inclusive the height of the small ridge diminishes and the clearance from the gulley becomes smaller until at about lot 21 there is very little catchment area between the toe of the north slope and the access road.

In this area the frequent small avalanches which fall from narrow paths among the trees on the north slope run directly across the lots mentioned above. This area is unsuitable for construction of housing. The existing house on lot 26 appears to be sufficiently well protected by a thick stand of timber and the rather short length of the slope above it. This particular lot may be considered reasonably safe.

A house presently exists on lot 21. This house is situated at the foot of a narrow band of trees with obvious avalanche paths on either side. Avalanching this past winter on these two paths brought snow debris to within about 30 feet of the house. This house does enjoy a certain amount of protection from the strip of timber up slope from it but this protection is extremely marginal. An overrun by a larger avalanche in either of the two paths could readily occur and would inflict serious damage to this house due to the very light construction of its timber foundation. Terrain configuration on lot 21 suggests that a rather large mound might be used as an avalanche barrier to protect this house. The degree of the protection probably would not approach 100% unless this mound were very large. Avalanching probably occurs in the two adjacent gulleys every year and the house as it presently stands is highly vulnerable. I recommend that this house preferably should be moved to a safer location.

It should be noted that the layout of the access road to Subdivision No. 2 has reduced the effective number of lots which could be considered reasonably safe from avalanche danger. If the access road had followed the earlier logging road immediately to the north it would have been possible to place several usable lots along the position of the existing access road. Several houses could have been constructed on these lots with some provision for reinforcing the south walls against windblast damage but in such positions that the prospect of damage from flowing snow would be minimal. The arbitrary application of road standards designed for lowland subdivisions to an alpine development can lead to such inefficiencies. It would be eminently worthwhile for both developer and the regulatory and taxing bodies involved to plan such areas as Yodelin on a total environmental basis which took fully into account features such as avalanches, snow deposition, vegetation and timber patterns which are peculiar to alpine environments.

Subdivision No. 3

The broad southeast facing slope of Mt. Lichtenberg embraces an avalanche area almost a mile wide. The western end of this slope normally channels sliding snow around a buttress and eastward to the floor of the valley occupied by Mason Creek. During unusually heavy avalanche activity, such as occurred in January 1971, the sliding snow on the western end of this area overruns the buttress and descend directly to the south toward the area occupied by Subdivision No. 3. The south-facing slopes of the buttress immediately above Subdivision No. 3 are long and steep enough to generate avalanches in themselves. Examination of terrain configuration and effects on the vegetation of the January 1971 avalanche suggest that the destructive effects of this avalanche on timber and houses in subdivision 3 came about in the following fashion. A large, possibly dry, snow avalanche originated high on the slopes of Lichtenberg Mtn. at about the 5500 foot level, fell at high velocity, crossed the top of the buttress, and as it descended the south slope triggered a secondary avalanche on this slope of the buttress. It appears that the additional sliding snow provided by this secondary avalanche provided most of the extra destructive power required to demolish a large amount of timber in the Subdivision No. 3 area. This was second growth timber in the order of 75 years old.

The situation at the western end of the big Lichtenberg Mtn. avalanche of January 1971 is especially noteworthy. The house occupying lot 48* was demolished by an avalanche late in December of 1970. Except for eye-witness accounts which described the occurrence of this December avalanche, there would be no way to distinguish between its effect and that of the Lichtenberg

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*This is the Lousberg residence. My notes show Lot 48 but in fact the enumeration of other lots suggest it should be Lot 38. Plats were not available at the time this report was prepared.

avalanche immediately to the east. The december avalanche apparently fell as a rather narrow slide while the January one extended across a broad front.

Terrain configuration at the top of the buttress suggests that the avalanche of December marks approximately the maximum western boundary of the large avalanche fall from Lichtenberg Mtn. It is possible, however, for avalanches originating below about the 4000 foot level on the buttress to fall farther to the west from this point.

The area of danger from the Lichtenberg Mtn. avalanche is now clearly defined. This area embraces all lots in Subdivision No. 3 except lots 22 through 35 inclusive. The avalanche danger to these exposed lots is now obvious and they should not be considered suitable for construction of houses. No further construction should take place on the endangered lots and the existing houses which have survived the past winter should be removed. A few lots escaped the sliding snow at the lower end of Subdivision No. 3 but there is no reason to believe at this point that another avalanche either by a slightly larger size or peculiarity of flow could not with equal ease overrun these lots.

The situation of the remaining lots in Subdivision No. 3, lots 22 through 35, requires further discussion. A substantial timber stand of the same age as that destroyed further to the east by the Mt. Lichtenberg avalanche exists on all of these lots. There is a possibility that an avalanche originating on the south face of the buttress could penetrate this timber and lead to possible hazard, especially above the access road on lots 30 through 35. This south slope is shorter here than it is farther to the east where the extensive destruction has already occurred, and while the degree of hazard is noticeably reduced, it is by no means zero. The lots located below the

access road, Lots 22 through 29, are probably reasonably safe from avalanching and can be utilized for residential construction. Lots 30 through 35, above the access road, cannot be considered entirely free of danger. Penetration of small avalanches among the timber can almost certainly be expected. For this reason if any houses should ever be built on Lots 30 through 35, they ought to be adjacent to the access road and provided with window-free uphill walls capable of resisting small avalanches.

The possibility of a large avalanche penetrating and destroying the timber above Lots 30 through 35 cannot be entirely discounted. An uncertainty exists here as a result of the manner in which the Lousure house was destroyed. Did this December avalanche originate high on Lichtenberg Mtn., or did it originate on the south slope of the buttress immediately above Subdivision No. 3? If the latter were the case, then there is a small but definite possibility that a similar avalanche could wreak similar damage farther west. If such avalanches occur here only when they fall from higher up Lichtenberg Mtn., then the chances of their falling farther west into Subdivision No. 3 is much smaller. Due to this uncertainty, I am inclined to take the more cautious view and recommend that no houses be built on Lots 30 through 35.

It should be noted in conclusion that the terrain northeast of the lowermost part of Subdivision No. 3 extending all the way across the slopes of the borad Lichtenberg Mtn. avalanche to the property line of the Yodelin development (Nason Properties) and including the floor of the valley of Nason Creek at the foot of this slope as well as the opposite slope between Nason Creek and U.S. 2 is exposed to a high degree of avalanche danger from the slopes of Lichtenberg Mtn. This entire area is unsuitable for the construction of residential housing or, for that matter, any development involving major structures of any kind. Summer use for campgrounds or parking lots may reasonably be considered, but this entire area exposed to the broad mile-wide

avalanche face of Mt. Lichtenberg should not be considered for winter use.

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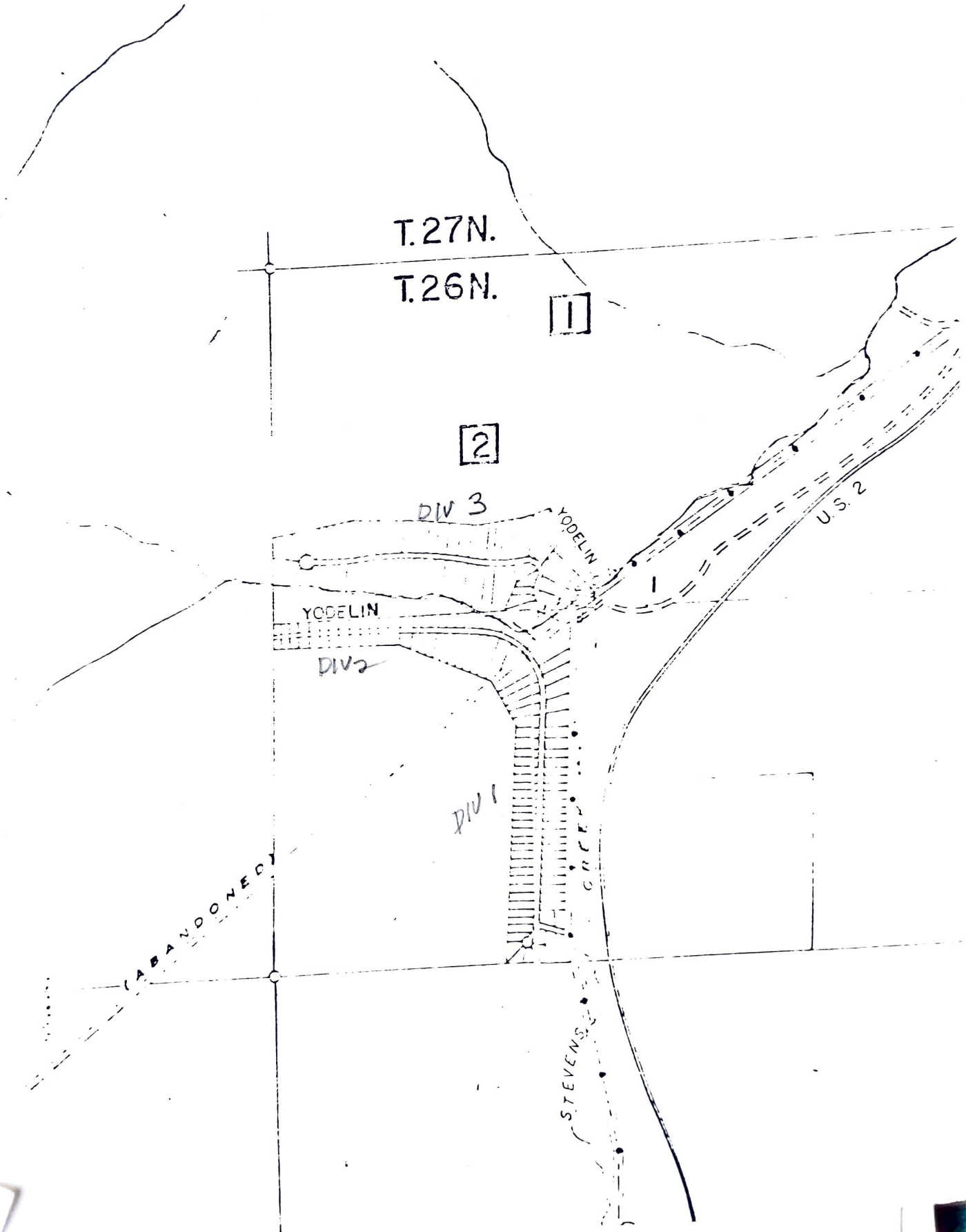
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