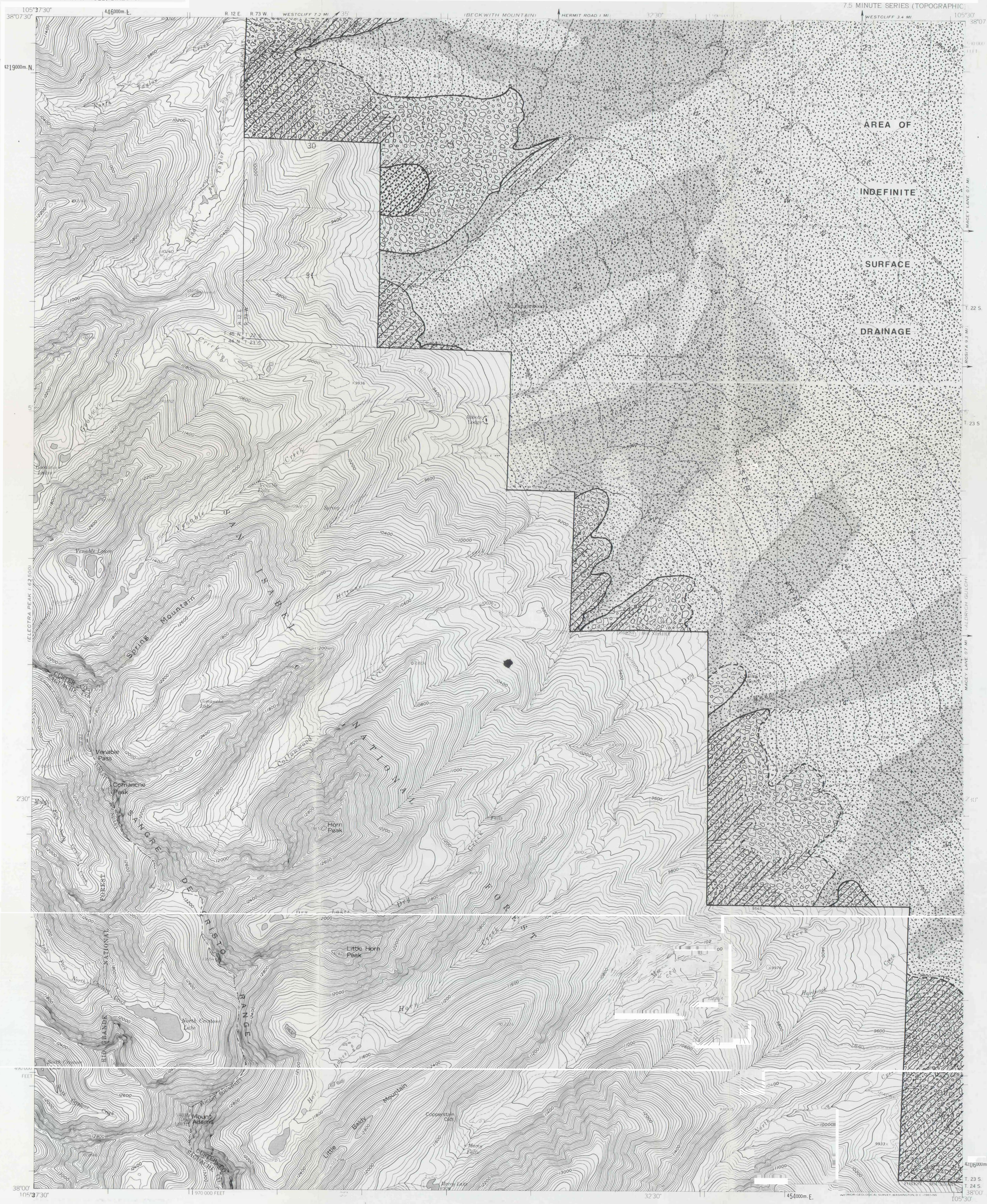
DEPARTMENT OF NATURAL RESOURCES
COLORADO GEOLOGICAL SURVEY
JOHN W. ROLD, DIRECTOR

HORN PEAK QUADRANGLE
COLORADO
7.5 MINUTE SERIES (TOPOGRAPHIC)



Base from U.S. Geological Survey
7.5-minute quadrangle

SCALE 1:24000

CONTOUR INTERVAL 40 FEET

ROAD CLASSIFICATION
Light-duty Unimproved dirt

QUADRANGLE LOCATION

COLORADO GEOLOGICAL SURVEY
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GEOLOGY FOR LAND-USE PLANNING HORN PEAK QUADRANGLE CUSTER COUNTY, COLORADO

BY JAMES N. PRICE, 1977

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GENERAL DISCUSSION

According to Colorado House Bill 1041, a geologic hazard is ". a geologic phenomenon which is so adverse to past current, or foreseeable construction or land use as to constitute a significant hazard to public health, safety, or to property." Because of this concern for public health, safety, and property, it is obvious that without the actual or prospective presence of man, geologic hazards would not exist. Man's normal activity and presence in an area transform many natural geologic conditions and processes into geologic hazards. Consequently, the primary objective of this study is to identify existing and potential geologic hazard areas on the private land in the Horn Peak quadrangle so that they can be avoided, controlled, or used in a manner that will have the least adverse effect upon the activities of man and the environment It must be stressed that this map is to be used only as a guide for general land-use planning purposes and not as a substitute for detailed engineering geologic, hydrologic, and soil and foundation investigations in areas of ntial or commercial development.

GEOLOGIC HISTORY

The formation of the majority of the geologic features in the study area can be traced to events during the Pleistocene Epoch, a time during which much of Colorado experienced colder temperatures and an abundance of snowfall. Accumulation of large amounts of snow along the Sangre de Cristo Range caused glaciers to form along the eastern slope of the range and advance down the steep mountain canyons toward the Wet Mountain Valley. As the glaciers moved eastward, they scoured the canyon walls and floors and picked up large quantities of rock debris that became incorporated into the moving masses of ice. At lower evaluations a point was reached where the accumulation of snow at the head of the glacier balanced the melting of ice at the termini [pl of terminus, the lower margin of a glacier]. Under such conditions constant internal movement of the glaciers brought a continuous supply of debris to the termini where it was deposited as terminal moraines.

Periods of warm temperatures during the Pleistocene resulted in a decrease in the supply of fresh snow to the head of the glaciers and an increase in the rate of melting at the termini, thus causing the termini to recede up the valleys and deposit rock debris along the canyon walls and floors forming recessional, lateral, and ground moraines. Streams fed by the melting glaciers carried large quantities of glacial debris and deposited it at the mouths of the mountain canyons, forming alluvial fans. Single tributary streams entering the fans branched into several distributary streams that deposited their heavy loads of sediment as they migrated across the fan surface. With continued deposition by sediment-laden streams these fans grew in size until they merged with similar fans at the mouths of adjacent canyons. The result was a series of coalescing fans that formed a broad, continuous alluvial surface, or a piedmont alluvial plain. However, the periodic return of colder temperatures during the Pleistocene greatly reduced the volume of glacial meltwaters as well as the amount of sediment deposited on the piedmont alluvial plain. Renewed accumulation of snow at the head of the glaciers caused them to move down the canyons once again, thus destroying many of the features that were formed during the previous glacial retreat.

After several glacial advances and retreats, the Pleistocene Epoch was brought to a close by the gradual warming of the climate and the final melting of the glaciers. Clear evidence of this past glacial activity is seen today in the features and materials the glaciers left behind.

Because of their mode of deposition, many of the glacial moraines are characterized by rugged topography and numerous steep, unstable and potentially unstable slopes. Other such slopes have been created both in glacial moraines and on the piedmont alluvial plain by recent downcutting of major streams. Geologic processes acting since the Pleistocene have caused at least two landslides on these unstable and potentially unstable slopes. Material deposited by the glaciers is still being removed from the mountains by present-day streams and deposited on the piedmont alluvial plain. Although the amount of material now moved by these streams is much less than that at the close of the Pleistocene, periods of rapid spring snowmelt, prolonged rainstorms, and intense thunderstorms still transport significant amounts of rock and organic debris from the mountains onto the piedmont alluvial plain. Consequently, some areas on the piedmont alluvial plain are still affected by the same depositional processes that were especially active during and at the close of the Pleistocene Epoch.

GEOLOGIC FEATURES AND RELATED HAZARDS AND CONSTRAINTS

Glacial Moraines and Related Glacial Deposits

The Glacial Moraines and Related Glacial Deposits were formed during and at the close of the Pleistocene Epoch as glaciers deposited large quantities of material ranging in size from minute clay particles to huge boulders. Because ice was the principal agent of deposition, the materials are unsorted and unstratified; therefore, significant concentrations of sand and gravel are generally absent. The presence of large boulders in these deposits will make excavations relatively difficult. Standard leach-field systems will be suitable for most low-density developments. Due to the rugged topography and numerous moderate to steep slopes, development will require extensive cuts and fills. Therefore, any development proposed on these deposits should be evaluated by a qualified engineering geologist or soils engineer so that appropriate steps can be taken to prevent the development of an unstable slope condition. In addition the nature of deposition and the large variation in material size in these deposits cause them to differentially compact when placed under load. Therefore, soils and foundation investigations should be conducted by a qualified soils engineer so that any adverse subsoil conditions can be recognized prior to construction. The abundant vegetation and well-developed organic soil cover in most of these areas prevent rapid erosion; therefore, removal of vegetation for excavations should be carefully controlled. Surface drainage is generally confined to existing valleys and well-defined stream channels. The recommendations of a qualified hydrologist regarding surface runoff and proper easements along existing stream channels should be closely followed for any development planned in these areas.

Piedmont Alluvial Plain

Most of the Piedmont Alluvial Plain was formed during and at the close of the Pleistocene Epoch as glacial meltwaters deposited large quantities of gravel, sand, silt, and clay at the mouths of steep mountain canyons, forming a broad, gently sloping alluvial surface. Selective movement and deposition of material by running water resulted in local accumulations of sand and gravel that may be suitable for general construction material. Because boulder-size materials are generally absent, excavations should not be difficult. Standard leach-field systems should be suitable for most low-density developments, although a high ground-water table in many low-lying areas will probably require other methods of sewage disposal. Development will require only minor cuts and fills due to the gentle slopes in most areas. Bearing capacities of these soils will be adequate for most structures, but because buried deposits of organic or clay-rich material may be present in some areas, soils investigations should be conducted by a qualified soils engineer so that these conditions can be recognized prior to construction. Except for Recent Outwash Zones (see below) and some areas of gullying, most areas on the Piedmont Alluvial Plain show little or no evidence of recent deposition or erosion. However, some intermittent streams as well as numerous old or inactive stream channels may carry significant amounts of water during periods of high runoff. Where well-defined stream channels are absent, shallow sheetflooding may occur. Therefore, although major flooding and deposition of material are unlikely outside of the Recent Outwash Zone, an adequate drainage and erosion-prevention plan should be required for any development on the Piedmont Alluvial Plain.

Recent Outwash Zones

Recent Outwash Zones are those portions of the Piedmont Alluvial Plain that have experienced significant erosion or deposition of material since the last retreat and final melting of the glaciers at the close of the Pleistocene Epoch. Each outwash zone contains at least one major stream that originates in the high country and that collects runoff from a relatively large drainage basin. Some of these streams have downcut into the piedmont surface, forming relatively narrow, well-defined natural flood plains. Most of the streams, however, are characterized by relatively wide, poorly defined flood plains, many of which contain several distributary streams. During periods of high runoff, these streams may overflow their banks and deposit relatively coarse debris adjacent to the main stream channel near the mouths of the steep mountain canyons where velocities are relatively high. Farther out on the piedmont where stream velocities are much lower and surface drainage is poorly defined, shallow sheetflooding and deposition of fine sediment are likely to affect a much larger area. In addition each Recent Outwash Zone contains many older, abandoned stream channels that, during periods of high runoff, may carry significant amounts of water and debris if debris jams or other obstructions force the main channel flow into these older channels. Consequently, these seemingly inactive channels adjacent to present-day streams should be treated with caution if development is planned near them. It should be noted that many of the Recent Outwash Zones represent relatively broad areas that have experienced significant erosion or deposition since the close of Pleistocene Epoch; therefore, present-day flooding may affect only a small portion of this zone. However, in order to accurately determine the limits of potential flooding, any development proposed within this Recent Outwash Zone should be preceded by detailed hydrologic investigations. Because these Recent Outwash Zones are located on the Piedmont Alluvial Plain, other factors affecting development in these areas are the same as those discussed above.

Landslides

Landslides result from the shearing failure and subsequent downslope movement of material in response to the pull of gravity. Only two recognizable landslides occur in the study area, both of which originated on relatively steep slopes in glacial till. Renewed or accelerated movement of the landslide material can be caused by disruption of the existing geologic conditions or natural geologic processes by removal of vegetation, increase in the moisture content of the material, extensive cuts, or the addition of weight by fills or permanent structures. Therefore, nonconflicting land uses such as recreation or open space are recommended. Other proposed land uses involving permanent human occupation on these landslides should be preceded by detailed engineering geologic investigations to evaluate the feasibility for the proposed development.

Unstable and Potentially Unstable Slopes

Unstable and Potentially Unstable Slopes include those relatively steep slopes that show evidence of either present instability or the potential of becoming unstable if disturbed. Failure of these slopes can be caused by disruption of the existing geologic conditions or natural processes by removal of vegetation, increase in the moisture content of the material, extensive cuts, and the addition of weight by fills or permanent structures. In addition development on steeper slopes generally results in more detailed and costly engineering techniques in order to assure slope stability and provide adequate access to homesites and efficient sewage disposal systems. Therefore, nonconflicting land uses such as recreation or open space are recommended. Other proposed land uses involving permanent human occupation on these slopes should be preceded by detailed engineering geologic investigations to evaluate the feasibility for the proposed development. It should be noted that some relatively stable slopes that would require access across unstable and potentially unstable slopes in order to be developed are included in this category. In addition subtle or gradual changes in topography and geology often require the boundary between unstable and potentially unstable slopes and stable slopes to be determined rather arbitrarily. Therefore, the boundaries between these areas should be considered as approximate.