ENVIRONMENTAL GEOLOGY

By Earl P. Olson

Land-use planning without environmental geologic input has a diminished chance for success because all the pertinent land data is not analysed. The recovery of a particular resource must be weighed against demitting or polluting other resources. Land-use decisions made on a local basis may be fragmented and are often inappropriate unless considered on a ranger-district scale. The geologic subjects discussed herein have a direct involvement with human needs because both hazards and attributes are outlined.

The subject matter of environmental geology considers engineering geology, landslides, faults and seismic reaction of materials, ground water, aggregate resources, solid waste and pollution abatement, watershed rehabilitation practices, and interpretive geology.

Heretofore, the land units have been defined with geology as only a portion of the description of the unit. Environmental geology recognizes the fact that rock units and earth materials themselves have hazards and attributes that transcend more than one land unit. (An active fault may transcend several land units, but we still want to know where the fault is so we will not construct a building or dam on it.)

Landslides

The land type map indicates several of the larger landslides in the Monticello District. A large number of small slides are not indicated on the map because of scale. The three major categories of landslides were recognized in the District. These include: (1) falls, (2) slumps (landslides of most engineering literature), and (3) flows. Only the largest landslides have been mapped. Smaller slides are indicated in some of the land type descriptions.

Several of the slides are generated by water that flows from the base of sandstone cliffs or from the base of igneous intrusions. The water moistens shale and other rock units in which the clay. content is high. The overlying blocks of rock slide on the slick surface. In other areas great quantities of rock fragments fall and in some cases "flow" from high cliffs or mountain tops. Numerous slumps (swedish circle slides) are located in the deeper soils and cohesive earth materials. Some are man caused (road building) and others are associated with steep slopes.

Arresting or stopping the three major landslide types is a costly procedure. Stabilizations includes surface and subsurface drainage structures and costly deflecting or arresting structures. However, it may be more prudent to avoid development of such areas.

The formations that generate the largest landslides are: (1) brushy basin, (2) shales of the chinle, and (3) Mancas formation. The formations that generate rock fall include the various igneous intrusions (stocks, lacoliths, dikes and sills) and Navajo, Kayenta and Dakota formations.

Faults and Earthquakes

The Monticello Ranger District is in Zone 1 of the earthquake map of North America. This means there are two more active zones in the United States and one less active zone. The most active zone is Zone 3 which includes such areas as San Francisco and the Wasatch Front. None of the faults in the District appear to be active. (That is they do not disturb alluvial, landslide, or other more recent geologic materials). However, one fault outside the District, but within four or five miles, has moved recently deposited materials.

Most of the faults are high-angle faults with rock to rock contact. Faulting has been very active in the Needles area but of course that is some distance away from forest lands. The most spectacular expression of faulting on the forest are Grabens. Grabens are blocks of rock that have moved down in relation to two sides. The most important of these is Shay Graben, Bridger Jack Graben, Verdure Graben, Hammond Graben, and Sweet Alice Gragen. In addition there have been a few landslides associated with these movements, but the faulting is not active.

Ground Water

The rainfall is relatively low in the Monticello District. There are very few perennial streams. The existing data indicates that the potential water resource will come primarily from ground water. The ground water will have to be won from rock units rather than earth materials such as gravel or sand.

The following formations have the best potential for ground water: Dakota, Buro Canyon Navajo, Moss Back member of the Chinle, Cedar Mesa member of the Cutter and the basal portion of the various igneous intrusions. Some of the water from the Dakota and Buro

Canyon units may be mineralized, and therefore, of poor drinking quality. The water from the Moss Back member of the Chinle and the Navajo appears to have the best quality.

We have no information on potential of ground water in the canyon bottom units. We could obtain this information with the refraction seismograph. This technique may indicate ground water in gravels and sands and will give us the depth of the water if present.

Aggregate Resources

No pits or potential pits located in the District are shown on the regional aggregate inventory. Each site that has been worked or each potential aggregate site should be located. Such information helps determine cost or feasibility of road construction or other recreation development. Quarry sites are located only if stones, gravel, or sand is not available for a specific project.

Solid Waste and Pollution Abatement

Recreation development on the massive sandstone rock units may contribute to pollution of the ground water resource. The sandstones are both permeable and porous in many instances. A vault toilet that leaks or pit toilets will pollute the ground water. Solid waste sites located on the sandstones will have to be lined or they also will pollute the ground water. All lagoons will have to be lined and no drain fields can be allowed on the sandstone rock areas.

Watershed Rehabilitation Practices

Some of the watershed rehabilitation practices should be reconsidered in the light of engineering geologic data. For instance, unlined reservoirs on the sandstone rock units will percolate water to the water table. Also, reservoirs on the shales or other rock units in which the clay content is high may generate landslide or even their own failure. Water will reduce cohesion in low plastic clays and especially silty clay or silty clay loam materials. Trench failures have been common in some of the watershed projects because of the fact a disc furrow may be a better practice because there will be less water concentrated.

Interpretive Geology

The Monticello District has many areas of beauty and educational interest. The Abajo Mountains are one of only seven mountain ranges in North America that are formed in part by laccoliths. A laccolith is an igneous intrusion into sedimentary rock that domes up the overlying sedimentary units. (Utah has four of these mountains: Henry, LaSal, Abajo, and Navajo. Colorado has three: Ute, Rico, and LaPlata, while Arizona has one, the Carrizo.) The Abajo mountains have two known igneous stocks (East Mountain and West Mountain) and two inferred stocks (Johnson Creek and Shay Mountain). These four igneous stocks have been in part the source of the encircled 31 laccoliths.

Some of the faults, displaced rock units, and rock structures are displayed in as clear a manner as any place on earth. Some of the rock units can be traced for hundreds of miles into other states. The rock units display segments of time, ecology, and life long since extinct from present conditions. The peculiar way in which the thick (or massive) sandstones weather are uniquely displayed also. These include photogenic forms and alcoves and shelters in which past Indians have lived. Some landslides are larger than a square mile in area and roads cut through these interesting land masses.

Fossil leaves have been found in the Dakota formation. Plecypods (clams, oysters, and scallops) have been found in the Mancos shale. Fossil wood and dinosaur bone have been found in the Brush Basin formation. Much of the latter material will work up into beautiful cabochons and other jewelry.

The Abajo Mountains should be designated a geologic area. There should be signs and scenic turnouts or overlooks along the road that traverses the mountains. Small displays should be set up at the ranger stations. Scenic tours reproduced with line drawing should be available for public use.