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Surficial geologic map of the Anchorage B-7 NW quadrangle, Alaska

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SURFICIAL GEOLOGIC MAP OF THE ANCHORAGE B-7 NW QUADRANGLE, ALASKA

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INTRODUCTION

The Anchorage B-7 NW map area is located in south-central Alaska about 30 km northeast of downtown Anchorage (fig. 1) within the political jurisdictions of the Municipality of Anchorage and the Matanuska-Susitna Borough. The map area includes parts of two physiographic provinces, the Kenai-Chugach Mountains and the Cook-Inlet-Susitna Lowland (Wahrhaftig, 1965), as well as part of Knik Arm, an extension of Cook Inlet.

The principal land element of the map area forms a part of the Anchorage lowland (Schmoll and others, 1984), a subunit of the Cook Inlet-Susitna Lowland that is characterized here mainly by low hills and intervening channels dominantly of glacial origin, and that also includes the broad alluvial fan of Peters Creek. The outer margin of the Anchorage lowland is commonly marked by cliffs that rise 25-150 m above the mean level of Knik Arm. Northwest of the Glenn Highway bedrock beneath the lowland consists mainly of soft sedimentary rocks that are almost everywhere concealed beneath the glacial deposits. The northwestern corner of the map area includes a small part of another subunit of the Cook Inlet-Susitna Lowland, the lower Matanuska valley.

The Anchorage lowland lies adjacent to the abruptly higher, rugged terrain of the Chugach Mountains composed mainly of structurally complex and variably metamorphosed sedimentary and igneous rocks of Cretaceous age and older (Clark and Bartsch, 1971; R.G. Updike and C.A. Ulery, Alaska Division of Geological and Geophysical Surveys, written communs., 1986, 1987; G.R. Winkler, written commun., 1986). Within the map area, the mountains attain an altitude of about 540 m and within a few kilometers to the southeast, altitudes of about 1,500 m.

Knik Arm dominates the hydrography of the region. This tidal estuary is flooded twice daily by brackish water that flows from the Pacific Ocean into Cook Inlet and then into Knik Arm. Mean tidal range at Anchorage (the closest tidal station) is 7.9 m while the difference between mean higher high water and extreme low water approximates 10.8 m (U.S. National Ocean Survey, 1982). Northeast of the map area, Knik Arm merges with the Knik and Matanuska Rivers (fig. 1). The complex interplay between the flood and ebb of tide water and seasonally variable river discharge results in substantial changes in the number and size of the mostly sandy islands in the arm. Principal streams within the map area include Peters, Little Peters, and Fire Creeks; all head in the Chugach Mountains. These streams commonly are entrenched from a few to several tens of meters below the general land surface. Peters Creek terminates in a broad alluvial fan delta, while underfit Fire Creek with much less discharge empties into an embayment partly filled with intertidal deposits.

Surficial deposits within the map area consist primarily of glacial drift in various landforms, chiefly kames and ground-moraine features, some of which are rudely formed drumlins. Many of the landforms are aligned northeast-southwest and parallel the southwestward direction of glacier flow. Exposed surficial geologic materials are primarily sandy to silty diamicton (till), lesser gravel and sand, and rare silt and clay. Secondarily, deposits are chiefly gravel and sand in glacial meltwater channels and in postglacial alluvial valleys. Some channels no longer contain even minor streams, and instead, contain organic deposits that may be substantially thicker than the

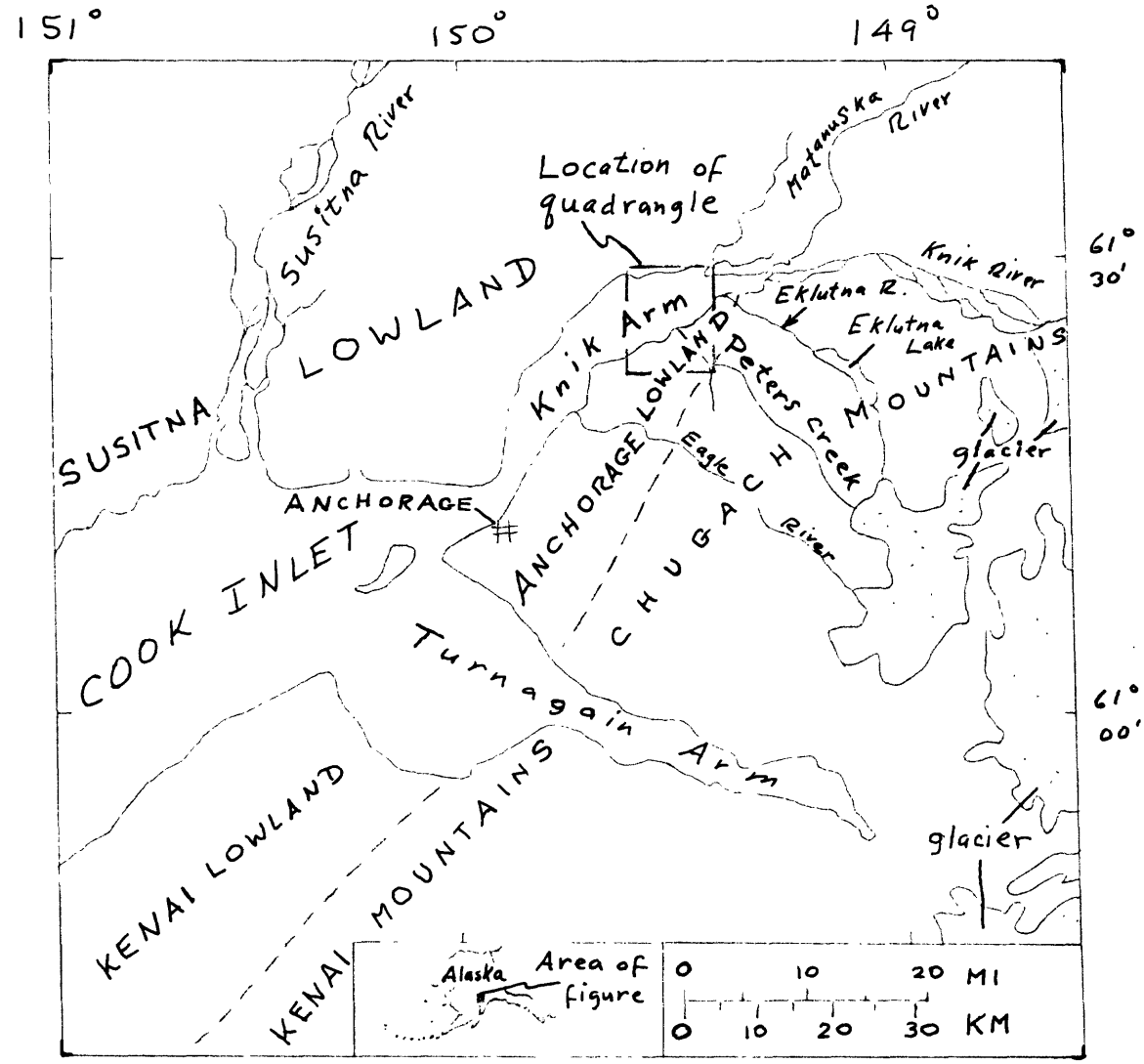


Figure 1.--Regional geographic features and location of quadrangle.

ubiquitous mantle of organic soil and wind-blown materials forming a thin cover over almost all natural landforms. Thirdly, in areas shoreward from the common storm beach along Knik Arm surficial deposits mostly consist of medium- to fine-grained shore, intertidal, and estuarine deposits.

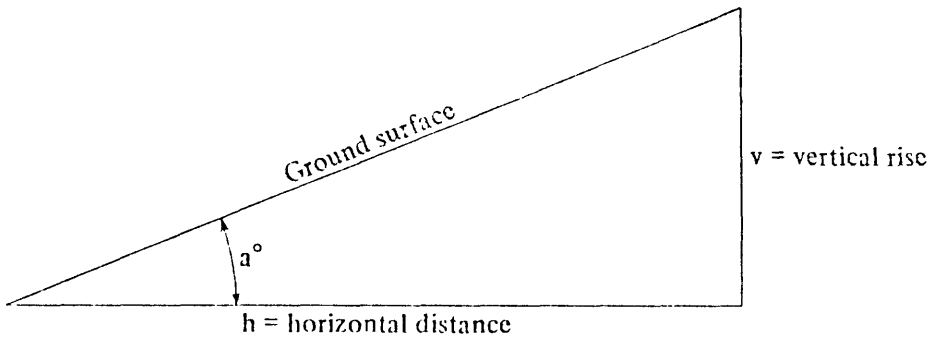
Several glacial advances and subsequent retreats have occurred in the area; the last advance and retreat produced most of the present-day terrain. Glaciers developed to the northeast of the map area, filled the Knik and Matanuska valleys to varying levels, and flowed southwestward. The resulting glacial deposits are mapped according to the principal lateral and end moraines with which they are associated (Schmoll and Yehle, 1986). The highest glacial deposits in well-formed lateral moraines in the map area are at 300 m along the flank of the Chugach Mountains and form part of a complex of moraines in relatively good continuity with the massive Elmendorf Moraine (Miller and Dobrovolny, 1959, p. 59) near Anchorage. Between about 12,000 and 10,000 yr ago, climatic warming resulted in the final stagnation and retreat of glacier ice thus ending the domination of the map area by glaciers. The Holocene geologic history of the area has been dominated primarily by alluvial and secondarily by colluvial processes. These processes have resulted in: (1) widespread deposits of alluvium, (2) locally steep slopes along streams and along Knik Arm, and (3) a variety of slope deposits.

The surficial geology initially was mapped at 1:63,360 scale by H.R. Schmoll and Ernest Dobrovolny between 1965 and 1971, mainly by interpretation of 1:40,000-scale airphotos taken in 1957 and by field investigations. Additional field investigations were undertaken by H.R. Schmoll in 1973, 1975, and 1976. Mapping subsequently was enlarged to 1:25,000 scale by L.A. Yehle and H.R. Schmoll, 1986, with additional detail derived from interpretation of 1:24,000-scale airphotos taken in 1972 and 1973 and from some field investigations in 1986. Early versions of surficial geologic maps were presented in Schmoll and others (1971), Zenone and others (1974), Brunett and Lee (1983), and Schmoll and Emanuel (1983). Additional surficial geologic data is from Daniels (1981) and Reger (1981). Bedrock data is modified from Clark and Bartsch (1971), Schmoll and others (1971), R.G. Updike and C.A. Ulery, Alaska Division of Geological and Geophysical Surveys, (written commun., 1986), and G.R. Winkler (written commun., 1986).

The base map was derived from a 1:25,000-scale preliminary topographic orthophoto map that was prepared using several different series of airphotos taken at several different tide- and river-level stages in 1972, 1973, and 1974. These various stages were not altitudinally adjusted to a uniform stage level for presentation on the orthophoto map as printed. As a result, and to more informatively portray islands and their deposits for our geologic map, several additional maps and charts were examined and interpreted (U.S. Geological Survey, 1960; U.S. National Ocean Survey, 1976, 1977, 1982).

DESCRIPTION OF MAP UNITS

[The map (plate 1A, in pocket) delineates deposits estimated to be 1 m or more in thickness. Estimates are based primarily on field observations. Grain sizes of unconsolidated particles follow the classification of the American Geological Institute (1958). Slope categories, from Schmoll and Dobrovolny (1972), are illustrated in figure 2, and are generalized estimates derived mainly from the slope map in Zenone and others, 1974, p. 2 and fig. 3. Standard age symbols are omitted from map symbols because all units except bedrock are entirely of Quaternary age. Correlation of map units is shown on plate 1B (in pocket)]



Diagrammatic representation of slope-measuring terms

Slope in percent = v/h × 100
Slope angle in degrees = a°
Slope ratio = h:v (h to v) where v is equal to 1 unit of measurement

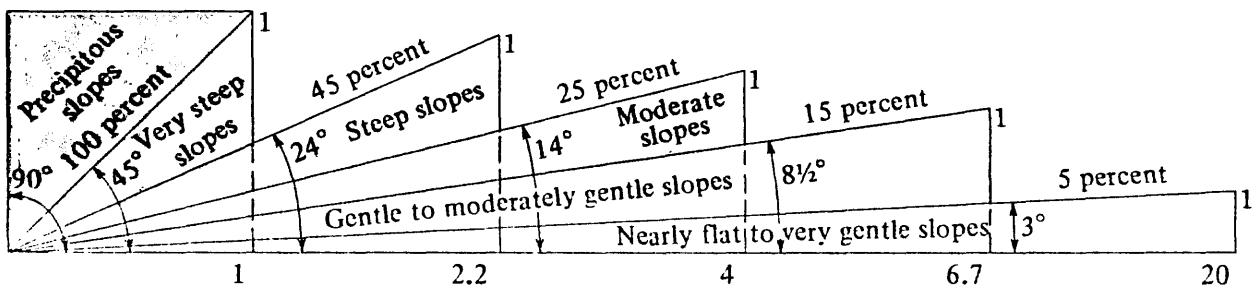


Figure 2.--Diagram illustrating slope categories used on this map (after Schmoll and Dobrovolny, 1972).

GLACIAL DEPOSITS OF THE ELMENDORF MORAINE (LATE PLEISTOCENE)

eml **In lateral moraines**--Chiefly diamicton consisting of massive, unsorted to poorly sorted mixtures of gravel, sand, silt, and relatively minor amounts of clay; includes scattered boulders. Moderately to well compacted. Occur as remnants of narrow ridges on the lower flanks of the Chugach Mountains (fig. 1). Thickness poorly known, but probably several to about ten meters; in places bedrock may occur at relatively shallow depth. Contacts with colluvium generally gradational, other contacts more sharply defined. Topography moderately irregular; slopes gentle to moderate on small areas on ridge tops, moderately steep to steep on ridge sides. Relatively more stable than other deposits on mountain slopes except for bedrock; some instability expectable on steeper slopes

emg **In ground moraine**--Chiefly diamicton consisting of massive, unsorted to poorly sorted mixtures of gravel, sand, silt, and some clay; includes scattered boulders; in many places may be a poorly sorted silty sandy gravel; locally may include small beds of better sorted gravel and sand. Moderately to well compacted. Thickness several to a few tens of meters, commonly overlying older glacial deposits. Contacts generally well defined, gradational with ground moraine in drumlin form and with colluvium. Topography smooth, slopes generally moderately gentle to very gentle

emd **In ground moraine with well developed drumlin form**--Similar to ground moraine to which it grades laterally, but occur in low elongate hills. Thickness a few to several tens of meters. Slopes commonly moderately steep on sides of hills

emb **In ground moraine that may thinly cover bedrock**--Similar to ground moraine but may be only one to a few meters thick. Underlain by bedrock which may be exposed locally

emk **In ground moraine that includes some kame deposits**--Similar to deposits of ground moraine but may include gravel and sand in large part or in areas too small to map separately at 1:25,000 scale

ek **In kames, locally including eskers**--Chiefly pebble and cobble gravel and sand, moderately to well bedded and sorted; some silt, and, especially in the cores of hills, diamicton similar to that of ground moraine; locally may include boulders. Moderately loose, but compact in cores of hills. Thickness a few to several tens of meters in central parts of hills. Contacts well defined. Topography sharply hilly to hummocky, depressions common locally; slopes steep to moderately steep, except gentle to nearly flat in minor channels, on depression floors, and on some small areas on tops of hills

ekl **In kames of generally low relief**--Similar to other kame deposits but may be thinner. Occur in moderately irregular topography with gentle to moderate slopes

ekt **In kame terraces**--Gravel and sand, well bedded and sorted; may include some lenses of diamicton and some boulders. Thickness probably a few to several tens of meters. Contacts well defined. Topography smooth, slopes nearly flat to gentle

ec **In meltwater channels**--Chiefly gravel and sand, well bedded and sorted; at the surface may include some finer-grained material with thin organic accumulations. In places channel deposits may be very thin or lacking and channel floored instead by ground moraine or, as along part of channel now followed by Mink Creek, underlain at shallow depth by bedrock (R.G. Updike and C.A. Ulery, Alaska Division of Geological and Geophysical Surveys, written commun., 1986). Thickness poorly known, probably one to a few meters. Contacts well defined. Topography smooth, slopes nearly flat to very gentle

OLDER GLACIAL DEPOSITS (PLEISTOCENE)

fmg **In ground moraine of the Fort Richardson moraines**--Chiefly diamicton consisting of poorly sorted mixtures of gravel, minor sand and silt, and some clay; coarser materials probably dominate; locally includes some boulder-sized rubble. Thickness poorly known, probably one to several meters; bedrock may be present at shallow depth. Contacts with bedrock are approximately located. Topography somewhat irregular to moderately hummocky, slopes generally moderately gentle to moderate. Located in southeastern part of map area

fkf **In kame fans related to the Fort Richardson moraines**--Probably mainly gravel and sand that is well to poorly bedded and sorted; may include beds of silt, fine-grained sand, and some clay, as well as some diamicton. Thickness poorly known, possibly as much as a few tens of meters. Contacts gradational with colluvium. Topography generally smooth, slopes moderately gentle to moderate, locally steeper. Located in southeastern part of map area

g **In stratigraphic exposures not readily related to surface moraines**--Diamicton consisting of poorly sorted mixtures of gravel, sand, silt, and clay; commonly material is more oxidized, finer grained, and more compact than deposits in ground moraine at the surface. Thickness probably several to a few tens of meters, and locally quite thin overlying bedrock. Probably extensive beneath glacial deposits of the Elmendorf Moraine in much of the map area. Contacts well defined; mapped area mostly along Glenn Highway and somewhat exaggerated in size in order to show at 1:25,000 map scale. Slopes of exposures steep, and largely covered by minor colluvium and vegetation; subject to minor slumping

ALLUVIAL DEPOSITS (HOLOCENE)

Alluvium deposited by moderate and small streams. Generally well bedded and sorted, clasts commonly well rounded. Thickness variable, probably a few to several meters, and thickest in large valleys. Contacts well-defined. Topography smooth, slopes nearly flat to very gentle

al **Along modern streams and in lowest terraces**--Chiefly gravel and sand. Generally within a meter or a few meters of stream level. Includes the narrow active floodplain of Peters Creek which may be subject to minor erosion, redeposition of material, and occasional flooding

alf **Along some minor streams, fine grained**--Chiefly silt and fine-grained sand; may include some peat deposits near surface; in places along Mink Creek bedrock occurs at shallow depth (R.G. Updike and C.A. Ulery, Alaska Division of Geological and Geophysical Surveys, written commun., 1986)

at **In terraces**--Older alluvium, chiefly gravel and sand. Along Peters Creek downstream end merges imperceptively with both younger and older alluvial fans along Peters Creek, upstream end separated from some older fan deposits by increasingly high escarpment

af **In alluvial fans**--Chiefly gravel and sand; mainly in large fan delta near mouth of Peters Creek where dominantly gravel; generally well sorted. In smaller fans materials commonly less well sorted and deposits may include some silt

aff **In alluvial fan, fine grained**--Chiefly silt and fine sand. Located at the mouth of Mink Creek

afo **In older alluvial fan**--Gravel and sand, possibly admixed with some finer-grained material; in small fan along Chugach Mountain front. Deposits may be less well sorted and have steeper slopes than in other alluvial units

afp **In principal alluvial fan along Peters Creek**--Chiefly gravel and sand located southwest of present-day steam; possibly may be graded as a fan delta to a level above present sea level, in which case could be very latest Pleistocene in age; alternatively might have extended substantially farther northwest into Knik Arm, and be graded essentially to present sea level but eroded to present distribution. Topography smooth; slopes very to moderately gentle, substantially steeper near head of fan. Especially near toe of fan constitutes major source of gravel and sand

PEAT, BOG, POND, AND LAKE DEPOSITS (HOLOCENE AND PLEISTOCENE)

p **Peat, bog, and pond deposits**--Chiefly mosses, sedges, and other organic material in various stages of decomposition; includes organic-rich silt, minor woody horizons, and a few thin interbeds of mainly ash-size tephra. At depth includes silt, clay, marl, and fine-grained sand. Developed mostly in small former bodies of water now the site of bogs. Soft and moist. Thickness as much as 4 m; adjacent mapped deposits extend beneath these deposits. Contacts well defined. Surface smooth, slopes less than one percent. Poorly drained

pf **Lake deposits of a possible lake along Fire Creek valley**--Probably consist of silt, clay, and fine-grained sand; may include peat near surface. Deposits not exposed and character and genesis mainly inferential. Alternatively, deposits could relate to a narrow inlet of Knik Arm and be of estuarine origin, or on the other hand, be mainly alluvium of Fire Creek. Thickness not known, but probably several to a few tens of meters. Contacts gradational to fine-grained alluvium of present Fire Creek. Surface smooth to slightly irregular with low relief; general slope less than one percent. Poorly drained

INTERTIDAL DEPOSITS (HOLOCENE)

il **Modern lower intertidal deposits**--Chiefly silt and fine-grained sand. Storm beach includes gravel and driftwood. Well bedded and sorted. Loose, water saturated. Reworked several times daily by tides; entirely covered by water of Knik Arm estuary at high tide, and mostly exposed at low tide. Thickness less than one to a few meters, probably underlain by several meters or more of older intertidal deposits. Contacts generally gradational and variable in location with each tide as well as from season to season and year to year. Contacts derived partly from base map, 1972 and 1973 air photos, U.S. Geological Survey (1960), and U.S. National Ocean Survey (1976, 1977, 1982). Lower boundary is a very generalized hypothetical mean tide line; standard mean lower low water line is about 4.6 m lower, based on the Anchorage tidal station. Upper boundary of the map unit includes the common storm beach which may be as much as several meters above mean high water line. Surface generally smooth, but incised one to a few meters by numerous channels that may have steep margins. Slopes otherwise nearly flat to gentle, commonly less than one percent

iu **Modern upper intertidal deposits**--Similar to the deposits of the lower flats except covered by water of Knik Arm only during exceptionally high tides coupled with extreme storms. Contains some organic material. Surface marked by some areas of standing water. Drainage very poor

io **Older intertidal deposits**--Chiefly silt and fine-grained sand, well bedded and sorted; locally may include thin beds of peat and other organic material. More firm than the lower and upper intertidal deposits. Not flooded by present-day high tides. Thickness several to a few tens of meters. Contacts well-defined, except gradational in part to younger intertidal deposits. Located in a shore embayment at the mouth of Fire Creek

COLLUVIAL (INCLUDING LANDSLIDE) DEPOSITS (HOLOCENE AND PLEISTOCENE)

cw **Colluvium on bluff walls along Knik Arm and tributary valleys**--Chiefly diamicton consisting of pebbly silt and sand with some clay, cobbles, boulders, and a variable amount of organic material. Poorly bedded and sorted. Loose accumulations derived from adjacent, upslope, deposits that form a veneer on bluffs following erosion. Generally a few meters thick, thinner at the upslope part and thickening downslope. Some contacts well defined. Slopes steep to precipitous. Although stabilized somewhat by commonly thick vegetative cover, subject to instability by local gully erosion or by renewed sea or stream erosion; generally unstable when excavated

cwf **Fine-grained colluvium on bluff walls**--Chiefly silt, clay, and fine-grained sand; poorly bedded and sorted. Occurs where upslope deposits are dominantly fine grained. Located along shore in eastern part of map area. Upslope deposits here may be equivalent to the Bootlegger Cove Formation (Miller and Dobrovolny, 1959; Updike and others, 1982) that underlies part of the Anchorage lowland. Thickness poorly known, probably a few to several meters. Slopes irregularly moderate to steep, and generally unstable

cg **Mixed colluvial and glacial deposits**--Diamicton consisting chiefly of gravelly to rubbly sand, silt, and clay; locally bouldery. Derived from both bedrock and from glacial deposits, either of which are likely to occur at the surface in areas too small to map separately at 1:25,000 scale. Poorly bedded and sorted. Loosely to moderately compacted in most places. Thickness varies from a few to several meters. Contacts gradational. Slopes smooth to slightly irregular, steep to very steep

cm **Colluvial deposits derived from moraines**--Diamicton similar to that of adjacent upslope moraines, but less compact; includes minor amounts of better sorted sand, silt, and pebbles in irregular beds. Commonly a few meters thick. Contacts generally gradational, especially upslope. Slopes generally moderate and moderately stable

cl **Landslide deposits**--Chiefly diamicton consisting of gravelly silt and sand and relatively minor amounts of clay and some organic material; may include boulders and some relatively large masses of bedrock. Includes earth-flow deposits. Nonbedded and poorly sorted. Relatively loose. Thickness poorly known, probably several meters to a few tens of meters. Contacts moderately well to poorly defined. Slopes irregular to slightly hummocky, and moderate to steep. Queried where identity uncertain. Located in southeastern part of map area

ANTHROPOGENIC DEPOSITS (HOLOCENE)

f **Engineered fill and areas extensively reworked by earthmoving equipment**--Chiefly compacted gravel underlain by a more poorly sorted base course of sandy to silty gravel; in reworked areas may include a more heterogeneous assemblage of material. Fill occurs mainly alony railroads and highways, reworked areas at major construction sites and in sand and gravel pits and bedrock quarries. Thickness one to a few meters, thicker where railroads and highways cross major valleys. Contacts well defined, width shown on map somewhat exaggerated where necessary to accommodate railroad and highway symbols

BEDROCK

by **Younger rocks (Tertiary)**--Sandstone, siltstone, claystone, and minor coal (Schmoll and others, 1971; Zenone and others, 1974) of the Tyonek Formation as defined by Wolfe and others (1966), Calderwood and Fackler (1792), and Wolfe and Tanai (1980). Poorly exposed in roadcut near Parks Creek, but presumably occur at depth beneath surficial deposits in at least part of the lowland part of the map area, especially northwest of the Glenn Highway. Only a few meters exposed in roadcut but may be many tens to perhaps 100 meters thick at depth

bo **Older rocks (Permian to Cretaceous)**--Chiefly metamorphosed igneous rocks of the Peninsular terrane (Jones and others, 1981, 1984; Coney and Jones, 1985), including greenstone, greenschist, and gneiss; metadiorite, metaquartz-diorite, chert, metaargillite, and marble. Secondarily, includes mainly metamorphosed sedimentary rocks of the McHugh Complex (Clark, 1972, 1973), mostly metagraywacke and metaconglomeratic graywacke

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