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GEOLOGICAL SURVEY

GROUND-WATER RECONNAISSANCE OF PART OF THE LOWER KENAI PENINSULA, ALASKA

By Gordon L. Nelson and Paula R. Johnson

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ILLUSTRATIONS

INCH-POUND UNITS AND SI METRIC EQUIVALENTS

Multiply	by	to obtain
inches (in.)	25.40	millimeters (mm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)
square miles (mi^2)	2.590	square kilometers (km^2)
cubic feet per second (ft^3/s)	0.02832	cubic meters per second (m^3/s)
gallons per minute (gal/min)	0.06309	liters per second (L/s)
gallons per day (gal/d)	3.785	liters per day (L/d)

GROUND-WATER RECONNAISSANCE OF PART OF THE LOWER KENAI PENINSULA, ALASKA

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ABSTRACT

Most residential and industrial development in the study area is along the coast of Cook Inlet. Most of the information about subsurface conditions is obtained from wells along the coast. Ground water is recharged by local precipitation, and slow drainage of ground water to the streams maintains streamflow during winters and periods of no precipitation. Sedimentary bedrock of the Tertiary Kenai Group is the principal source of water to wells, but subsurface data are too sparse to differentiate individual aquifers within the bedrock. Most bedrock wells are completed in poorly consolidated sandstone. Glacial till overlies bedrock in much of the study area, but few wells obtain water from the poorly permeable till. Glacial outwash and abandoned-channel deposits in major drainageways of alluvial plains provide water to wells but are little utilized and have not been explored by drilling. Intermorainal valleys and areas of low relief are poorly drained, and bog deposits overlie surficial materials in parts of the area. Bog deposits contain highly colored, iron-rich water that is undesirable to most consumers. Lacustrine clays overlie and are interbedded with fluvial materials and contain little extractable water. Streams have incised older glacial sediments and deposited alluvium along the present flood plains. Where the alluvium is thick enough, it has good potential for providing ground water to high-capacity wells. However, production of ground water from alluvium or other deposits hydraulically connected to streams will reduce streamflow. Surficial deposits with the best potential for developing significant ground-water supplies in the study area are the deltaic complex near the mouth of Kasilof River, the alluvium of Crooked Creek, and abandoned-channel deposits in the alluvial plain near Ninilchik and in an ancestral drainageway of Tustumena Glacier south of Crooked Creek.

INTRODUCTION

The study area (fig. 1) consists of that part of the Kenai Peninsula west of the Kenai National Moose Range that has not been described by previous hydrologic reports. Most residential and commercial developments within this area are along the coast. This coastal area has been subdivided into seven sections (fig. 2) that are described in greater detail than the more remote uplands area.

This report describes the distribution and hydrologic properties of known aquifers and relations between ground water and streamflow. These relations were analyzed from streamflow information. The distribution of shallow aquifers was determined largely by airphoto interpretation of surficial materials. Properties of shallow aquifers were estimated from sparse well-log information and by inferring grain size from the mode of sediment deposition. The distribution of water-bearing zones in the deeper bedrock can be analyzed only by correlation of well logs. However, throughout most of the study area, well data are too sparse for correlation, and only general conclusions can be made about water-bearing characteristics of bedrock.

This study was made under a joint agreement between the U.S. Geological Survey and the Kenai Peninsula Borough. The preparation of this report was financed in part by funds from the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and administered by the Division of Community Planning, Alaska Department of Community and Regional Affairs.

Karlstrom (1964) described the glacial history and surficial materials of the area. Anderson and Jones (1972) described the water resources of the Kenai-Soldotna area to the north of the study area, and Waller, Feulner, and Morris (1968) discussed the hydrology of the Homer area to the south. Hinton (1971) analyzed and mapped soils of the study area. Reger (1977) mapped landforms and made general interpretations of surficial materials. Most of the maps in this report are modified from Reger's work.

Geologic maps in this report are simplified to present information of hydrologic significance. Small landforms that are not hydrologically significant are combined into larger adjacent units. For example, some small alluvial fans are included with the valley alluvium which they overlie. Over large parts of the study area, unconsolidated materials are thin and discontinuous. Small bedrock outcrops on hilltops and steep slopes are not mapped because they are not significantly different hydrologically from adjacent areas that have a thin cover of unconsolidated materials. Beach deposits along Cook Inlet are also not mapped because they contain salt water and are not potential sources of water for most types of consumption.

Poorly consolidated sedimentary bedrock of the Tertiary Kenai Group is similar in appearance and drilling characteristics to the overlying unconsolidated materials. Therefore drillers and geologists often find it difficult to distinguish the contact between consolidated and unconsolidated materials in wells. In this report the authors have generally assumed that the presence of significant amounts of gravel indicates unconsolidated materials. The upper two formations of the Kenai Group, the Beluga and Sterling Formations, are composed primarily of

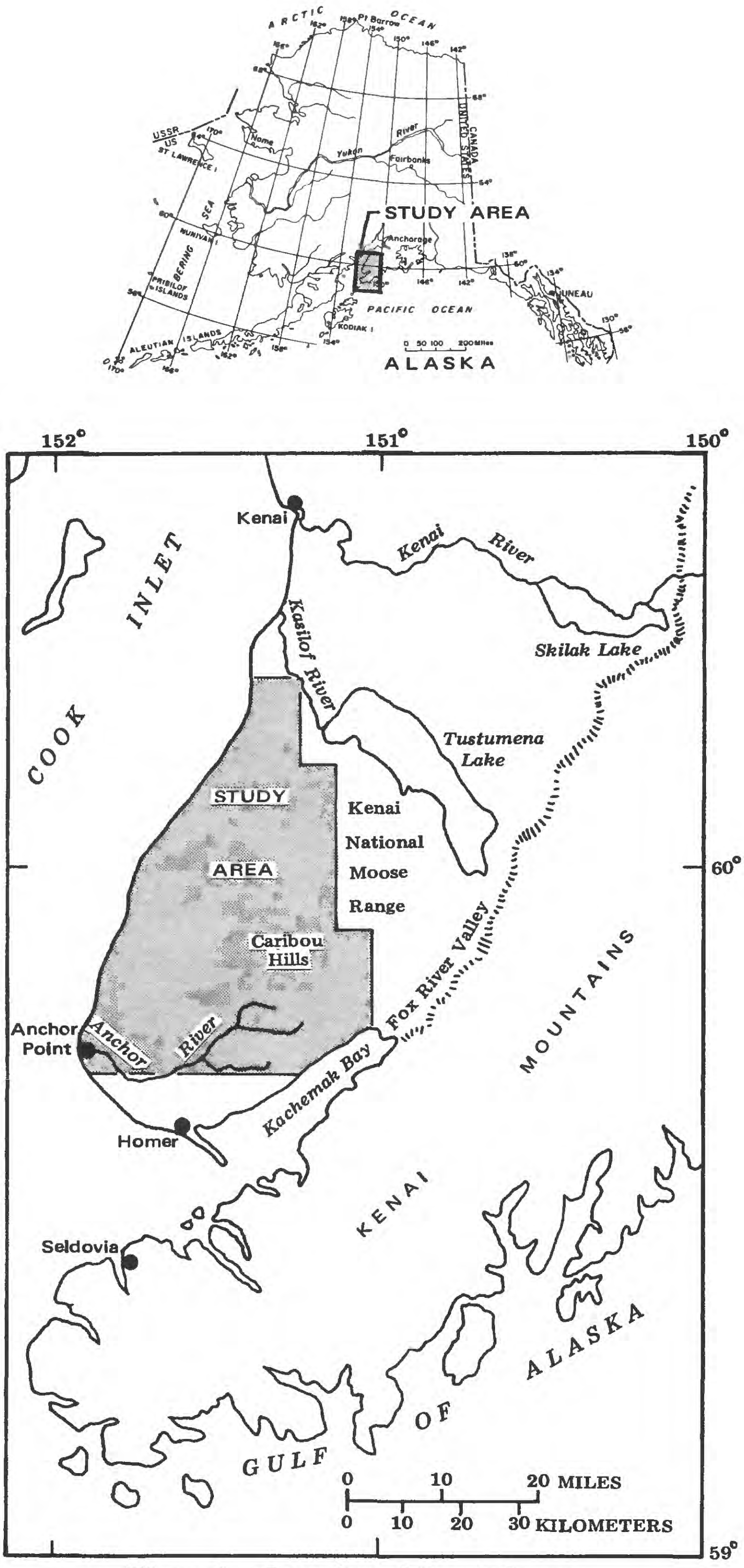

Figure 1. -- Location of the study area.

sandstone, siltstone, and coal. Descriptions of the type section of the Beluga Formation (Adkison and others, 1975) and detailed logs of exploration test holes drilled by Ideal Basic Industries (R. P. Comstock, Ideal Basic Industries, written commun., 1978) in the southern part of the uplands indicate that conglomerate (consolidated gravel) is rare in the bedrock. Although the difference between consolidated and unconsolidated materials is lithologically slight, it appears to be hydrologically significant because all high-capacity industrial and municipal wells in the Cook Inlet basin are completed in unconsolidated materials.

An analysis of the quality of water in the many aquifers in the area was beyond the scope of this project. However, many homeowners reported that their wells produced water having color and concentrations of iron that they considered unpleasant. No wells are known to yield salty or brackish water, but McGee (1977) postulated that deep wells south of Ninilchik might penetrate aquifers containing slightly to moderately salty water. From oil-well data he believes the freshwater aquifers are only 300-600 ft thick in the area between Ninilchik and Homer.

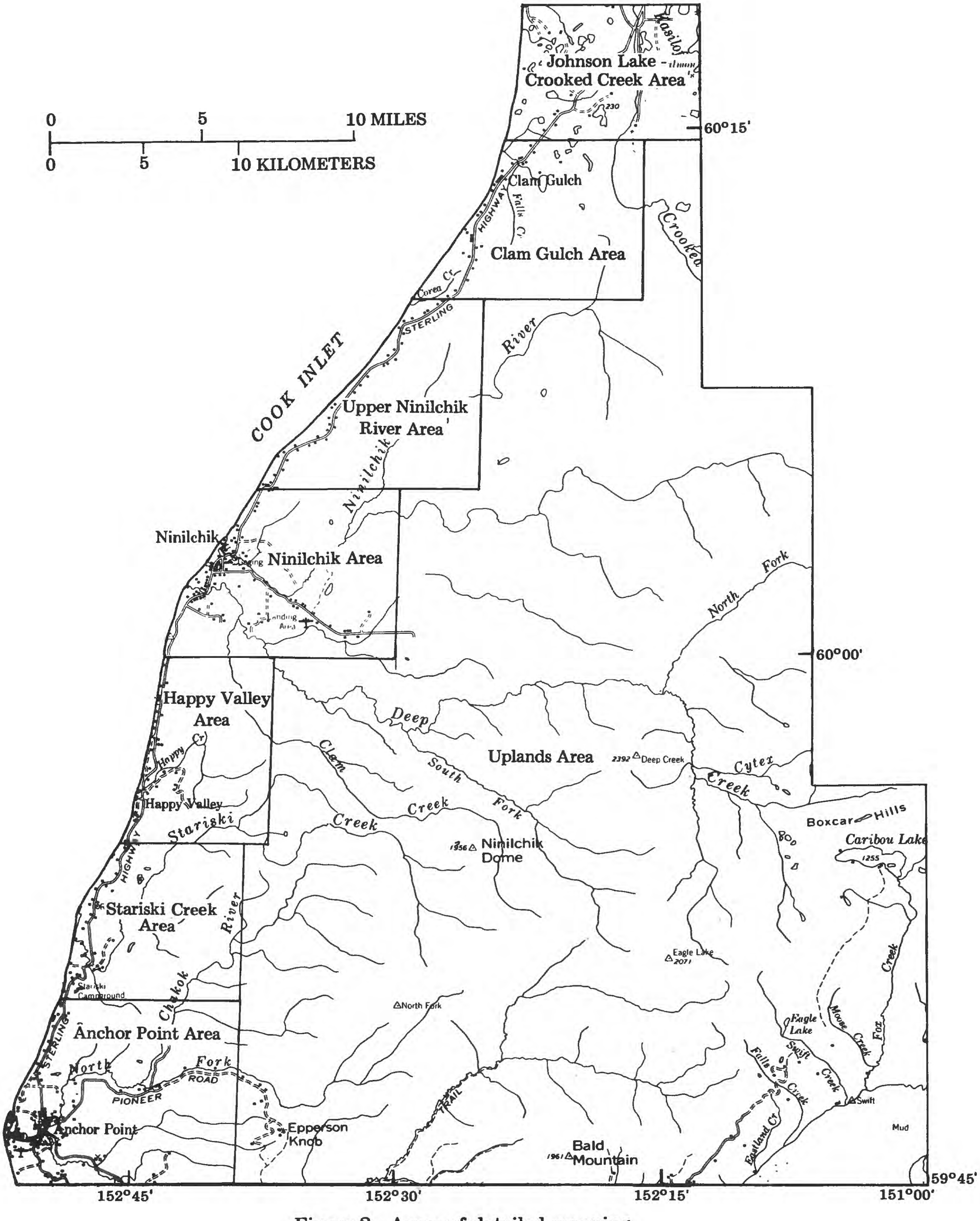

Figure 2.--Areas of detailed mapping.

HYDROLOGIC SYSTEM

Hydrologic Setting

The hydrologic setting of the study area is depicted in figure 3. Water falling to the land surface as precipitation flows overland into streams and infiltrates into the soils. Of the part that infiltrates, some returns to the atmosphere by evaporation and plant transpiration, and some percolates downward to the water table where it recharges the ground-water system. Ground water flows toward the coast and toward streams. Ground water seeping into streams maintains streamflow during periods of no rainfall or snowmelt.

Precipitation

The National Weather Service has maintained climatic-data stations at Homer since 1936 and intermittently at Kasilof since 1952. The record for Kasilof has 22 complete years of record between 1952 and 1979. Mean annual precipitation at Homer is 23.06 in.; at Kasilof it is 16.52 in. The National Weather Service has intermittently collected data at Ninilchik, but uninterrupted record is available for only the 1959 and 1960 water years. (A water year is October 1 to September 30.) Precipitation data for these two years are (in inches):

	Homer	Ninilchik	Kasilof
1959	21.97	20.00	16.79
1960	25.74	25.72	16.84

These data suggest a good correlation between the Homer and Ninilchik data.

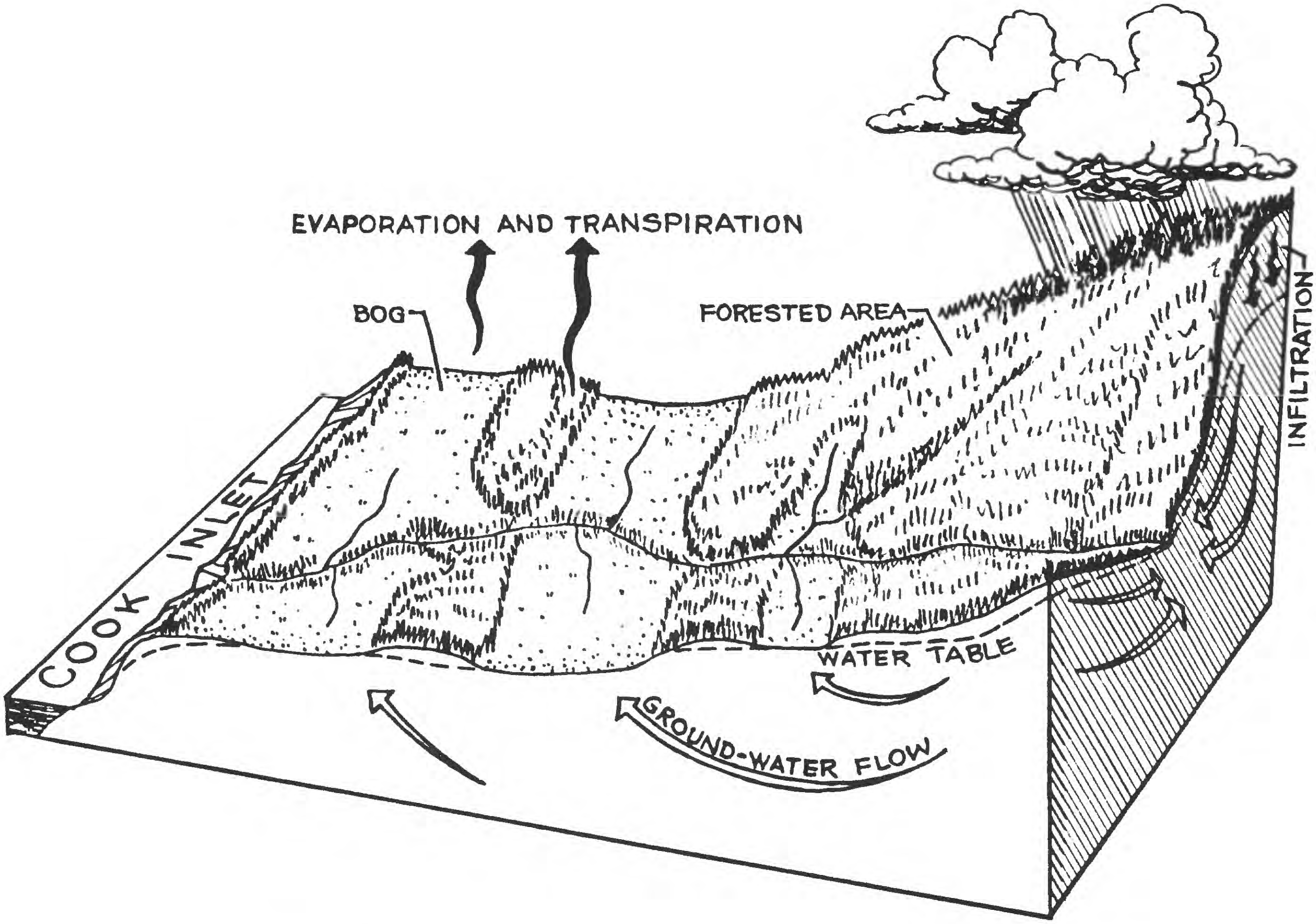

Figure 3. -- Hydrologic setting of the study area.

Streamflow to Ground-Water Relations

Many streams drain the study area. Continuous-discharge records have been collected by the U.S. Geological Survey on three of these. The periods of record and mean discharges are:

Anchor River near Anchor Point:	June 1965 - September 1973; October 1978 - present	184 ft^3/s
Kasilof River near Kasilof:	July 1949 - September 1970	2,385 ft^3/s
Ninilchik River at Ninilchik:	April 1963 - present	105 ft^3/s

Much of the annual streamflow is derived from seepage of ground water into the streams. This seepage maintains stream discharge during winter or during periods of no precipitation. Hydrograph separation techniques can determine the part of streamflow that is derived from ground water (DeWiest, 1965). The Anchor River hydrographs were analyzed for the years 1970-73 and 1979 and the Ninilchik River hydrographs for the years 1971-79. For these periods, 61 percent of the Anchor River streamflow and 68 percent of the Ninilchik River streamflow were derived from ground water. No hydrograph separation was performed on Kasilof River because low flow is sustained primarily by drainage from Tustumena Lake (fig. 1).

The quantity of streamflow derived from ground water (termed baseflow) is a minimum estimate of recharge to the ground-water system. Actual recharge exceeds baseflow because some ground water is lost to evaporation and transpiration. Over a single year baseflow may also be affected by changes in ground-water storage in a basin. However, over a period of many years, storage losses compensate storage gains, and change is insignificant.

The baseflow in Anchor River near Anchor Point during 1970-73 and 1979 averaged about 123 ft^3/s for the 133-mi^2 basin. This baseflow is approximately equivalent to the ground-water recharge produced by the infiltration of 13 in. of precipitation over the entire basin. The baseflow for Ninilchik River is about 72 ft^3/s for the 131-mi^2 basin and is approximately equivalent to recharge of 7.4 in. of precipitation.

The rate at which streamflow decreases during extended periods of no precipitation (termed the streamflow recession) is controlled by the hydrologic properties of the aquifers and the average distance from the stream to the basin divide (Rorabaugh and Simons, 1966; Trainer and Watkins, 1975). Throughout most of the study area, these factors combine to make very slow recessions, particularly during the winter when losses to evaporation and transpiration are negligible. In both the Anchor and Ninilchik Rivers the recessions are so slow that it would take more than 300 days for the discharge to decrease one order of magnitude if there were no precipitation for that length of time. The combined effect of slow recessions and frequent aquifer recharge by precipitation is a nearly constant baseflow.

Geologic Setting

Landforms in the area have been formed by glacial, fluvial, and lacustrine processes during and after five major glacial advances (Karlstrom, 1964). During the first two of these advances, the entire study area was covered by valley glaciers flowing southwestward toward the mouth of Cook Inlet. During the third glacial advance, ice covered the entire study area except the tops of the highest hills in the uplands. Moraines produced by the second and third glaciations cover much of the study area. Other landforms produced by the first three glaciations have been obliterated by subsequent glaciations. During the fourth and fifth glaciations, glaciers may have formed proglacial lakes that intermittently covered parts of the area below an altitude of 500 ft. Also during these last two glaciations, ice filled the Fox River valley east of the Caribou Hills and Kachemak Bay to the south (fig. 1). Tustumena Glacier extended down the valley of Kasilof River to the coast, and lobes of ice advanced from the Fox River valley into passes through the Caribou Hills at the headwaters of Deep Creek and Anchor River. Streams flowing from these glaciers deposited fluvial materials in channels that approximately parallel present stream channels.

Geologic Materials

Bedrock consists of poorly to moderately consolidated sandstone, siltstone, claystone, and coal of the Kenai Group. Bedrock commonly crops out in streamcuts and coastal bluffs and is less than a few feet below land surface throughout much of the Caribou Hills Upland. Elsewhere, as much as 150 ft of unconsolidated materials covers bedrock. Unconsolidated materials thicken toward the coast and to the north.

Some of the sandstone has visible primary (intergranular) porosity, and porous sandstone provides water to many wells in the Kenai Peninsula. However, some of the sandstone does not have good porosity and permeability because it is silty or is tightly cemented. Siltstone and claystone do not have significant primary permeability and are usually poor sources of water for wells. Secondary (fracture) porosity and permeability may occur in all bedrock types.

Coal units have moderate potential for providing water to wells. Test drilling in the Kenai Group on the west side of Cook Inlet in 1979 and 1980 indicated that some coal units are significantly more permeable than the interbedded claystone and siltstone but less permeable than poorly consolidated conglomerate. Waller, Feulner, and Morris (1968) reported that springs issue from coal beds in the Homer area. Only one well in the study area is known to obtain water from a coal unit.

Till consists of unconsolidated and unstratified materials deposited directly by glaciers and overlies bedrock in much of the area. In the uplands, till occurs as a veneer that is generally less than 10 ft thick and fills small depressions in the bedrock surface. In the coastal areas, till occurs as gentle hills and ridges, or moraines, left behind as the glaciers receded. Morainal flanks are well drained, but drainage is poor in depressions. Till has low permeability, and most wells in morainal areas penetrate the underlying bedrock.

Kames and eskers, like moraines, are ice-contact features, but they were formed by water running on, beneath, or along the margin of a glacier. Like moraines, their flanks are well drained, but they are poorly drained in topographic depressions. Kame and esker deposits are generally composed of sand and gravelly sand. They have better potential for producing water to wells than till does, but poorer potential than most other fluvial deposits do. In this report moraines, kames, and eskers are collectively mapped as undifferentiated glacial drift.

Outwash deposits consist of sand and gravel that were deposited by melt water immediately downstream from a glacier. They are moderately to well sorted, porous, and permeable and have good potential for providing water to wells. The thickness of the outwash deposits is highly variable and ranges from 0 to more than 100 ft. Drainage is poor in areas of low relief but good along incised stream valleys. Sand and gravel outwash deposited in deltas at the mouths of rivers flowing into proglacial lakes may be interbedded with or grade into lacustrine silt and clay.

Abandoned-channel deposits in major drainageways of ancient glaciers consist of coarse sand and gravel, but those deposited by small low-gradient streams after the glaciers receded consist of sand and silty sand. Abandoned-channel deposits occupy low-relief areas in topographic lows. They are commonly poorly drained except where incised by streams. Land underlain by these deposits is sparsely developed because of the poor drainage conditions. Because of this sparse development, few wells have been drilled into these deposits; however, their composition suggests that they have good potential for providing water to wells.

Bog deposits composed of saturated silty peat overlie abandoned-channel materials and glacial drift in many areas of low relief. Because drainage and foundation conditions are poor, little development and no well drilling have occurred in bogs, and no subsurface data are available. Peat is probably not thicker than 30 ft in most areas. Although peat is saturated and porous, bog deposits are not significant aquifers because of water-quality limitations; color, concentration of iron, and odor in bog water are objectionable to consumers. Bog deposits are not mapped in this report, but are combined with the map units that they are interpreted to overlie.

Below an altitude of 500 ft, fine-grained marine and lacustrine silt and clay mantle many of the older deposits and are interlayered with fluvial deposits. The poorly permeable silt and clay inhibit recharge to deeper sediments and may locally confine artesian aquifers. Most of the marine and lacustrine deposits are not visible at land surface. Where these deposits do occur at the surface, they commonly mantle older sediments and are mapped with the underlying sediments.

Alluvium has been deposited along active streams that are incised in older sediments. Alluvium is well sorted and permeable, but these deposits are generally less than 20 ft thick and not extensive. The water table is near the level of the stream and usually only a few feet below land surface. Stream-valley alluvium has the greatest potential for producing large quantities of water to wells in valleys of streams that have aggraded their channels and formed alluvial deposits more than about 30 ft thick. Kasilof River and Crooked Creek appear to be the only streams that have deposited significant alluvial aquifers.

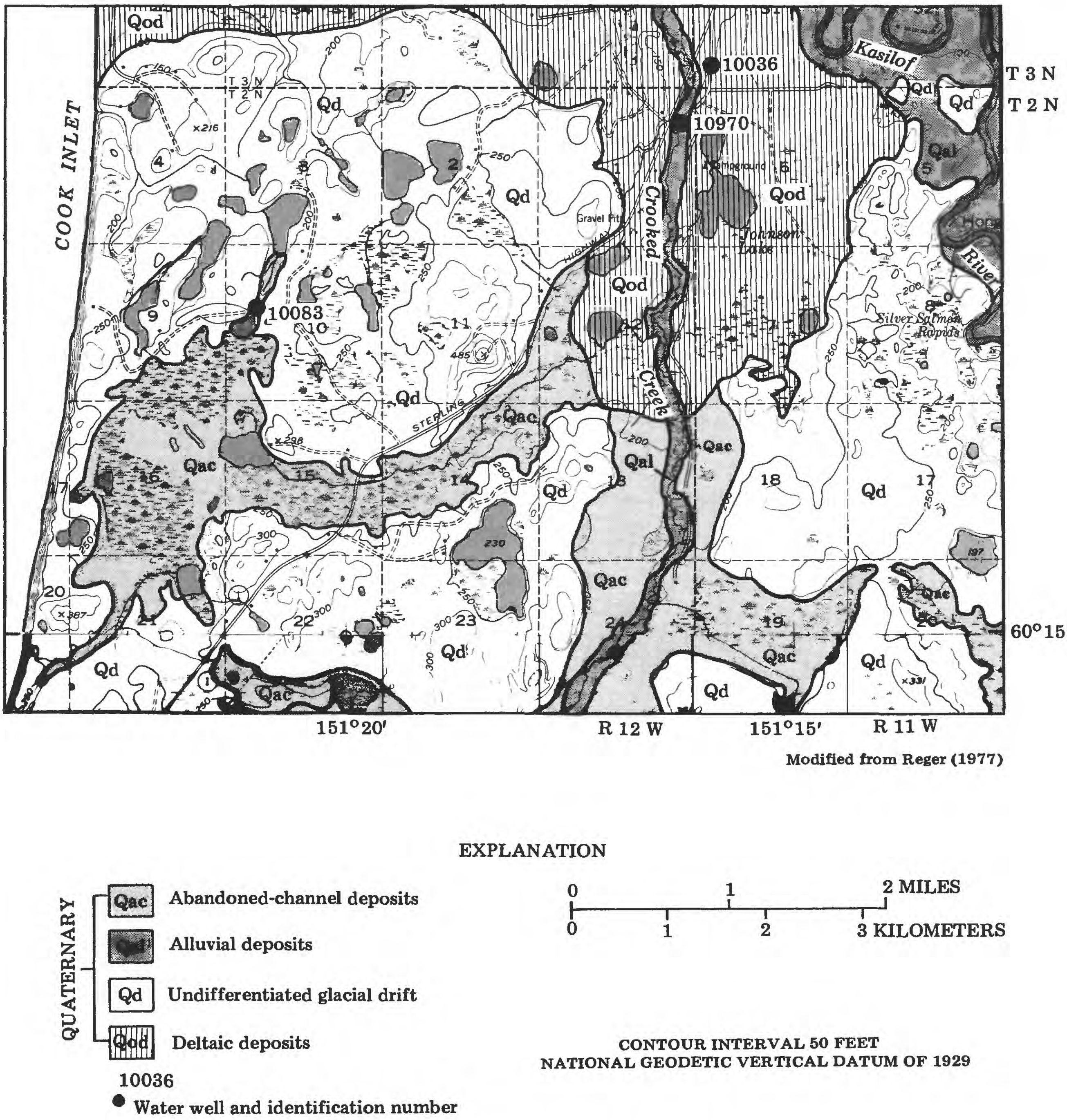

Figure 4.--Surficial geology of the Johnson Lake - Crooked Creek area.

JOHNSON LAKE-CROOKED CREEK AREA

The undifferentiated drift west of Crooked Creek consists of till, kame deposits, and lacustrine deposits (fig. 4). Till occurs under most of the hills, but kame deposits may underlie a few of the better drained hills. Kame deposits and sandy till may provide water to domestic wells, but most wells drilled in till will probably be completed in bedrock. Swales in the moraines are locally blanketed by lacustrine deposits. Thin deposits of fluvial materials may underlie the lacustrine deposits (well 10083, fig. 5) and provide water to domestic wells.

Abandoned-channel deposits occupy the low-lying, flat areas that approximately follow present drainages. Although no well logs are available from the abandoned-channel deposits, a water-table aquifer 30-80 ft thick commonly characterizes these sediments in the area north of the Kasilof River (Anderson and Jones, 1972).

Deltaic deposits consist of a downward- and seaward- fining sequence of gravel, sand, and silt. The uppermost sediments in the sequence are abandoned-channel deposits, but they are here mapped separately because they are underlain by finer materials at depth. At the Kasilof River bridge a few miles north of the study area, borings penetrated silty clay under the surficial sand and gravel. The only well in deltaic deposits in the study area (well 10036, figs. 4 and 5) penetrated gravel that grades downward to silty sand and sand.

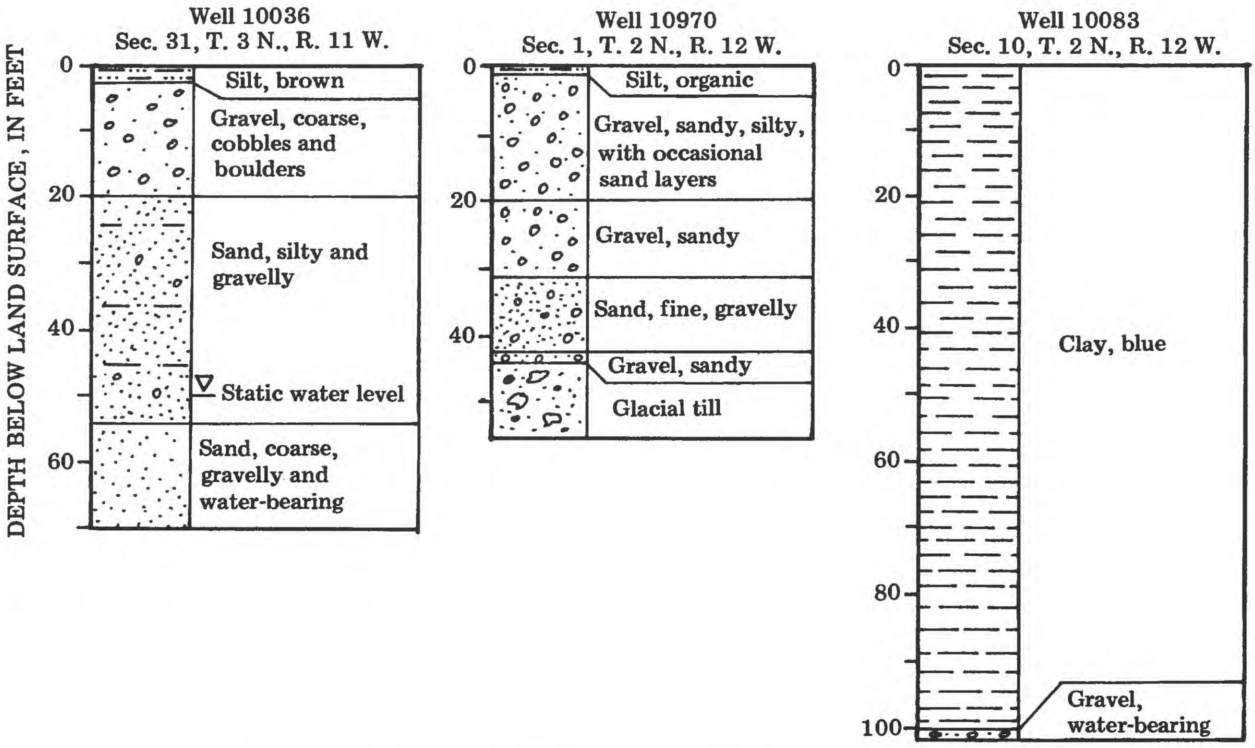

Figure 5.--Logs of selected wells in the Johnson Lake - Crooked Creek area. Locations of wells are shown in figure 4.

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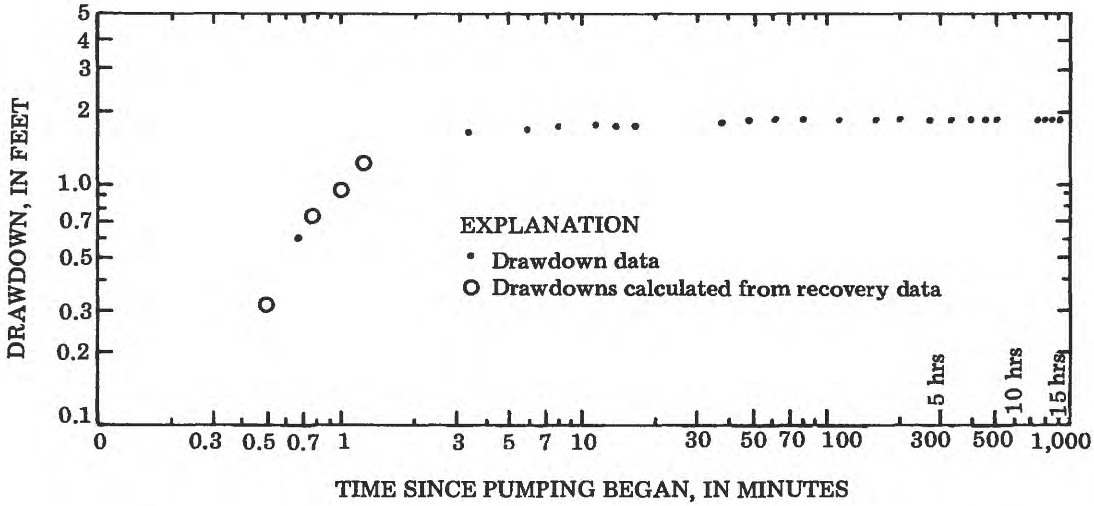


Figure 6.--Drawdown in observation well 8, located 19 ft from production well in Crooked Creek alluvium. Pumping rate was 60 gal/min. After 3 min, drawdown stabilized by infiltration from the creek.

The alluvium of Crooked Creek provides abundant water to wells. A test of the alluvial aquifer in sec. 1, T. 2 N., R. 12 W. showed rapid stabilization of drawdown by induced infiltration of streamflow (fig. 6).

CLAM GULCH AREA

The area south and east of Clam Gulch (fig. 7) consists of glacial moraines and intermorainal abandoned-channel deposits. Large parts of the abandoned-channel deposits are mantled by swamp deposits in which the water table is at land surface. The north-trending abandoned-channel deposit that flanks Crooked Creek in secs. 25 and 26, T. 2 N., R. 12 W. and continues south to sec. 14, T. 1 N., R. 12 W. appears to be a large melt-water channel from ancestral Tustumena Glacier. The channel is an extension of the abandoned channel along Crooked Creek near Johnson Lake and may contain coarse materials similar to those penetrated by well 10036 (figs. 4 and 5). This melt-water channel, if it contains materials similar to those penetrated by well 10036, has good potential for producing ground water to wells. The materials are also probably hydraulically connected to Crooked Creek, which flows through part of the old channel, and pumping from the abandoned-channel deposit may induce recharge from the stream. Other abandoned-channel deposits appear to be in small low-gradient drainages where streams deposited fine-grained materials such as the silty sand deposits discussed in the section describing Happy Valley.

The Crooked Creek alluvium in secs. 25 and 36, T. 2 N., R. 12 W., has the same potential for wells that induce infiltration as the Crooked Creek alluvium near Johnson Lake. The alluvium also connects with the abandoned-channel deposits of the former Tustumena Glacier outwash channel. Hydraulic communication between these units would increase the potential yield of both.

Drift occurs under the hills and is not known to provide water to any wells in the area. All well records in the Clam Gulch area are from three wells drilled in moraines near Clam Gulch. All these wells were drilled through the glacial till into bedrock and were completed at depths of about 300 ft.

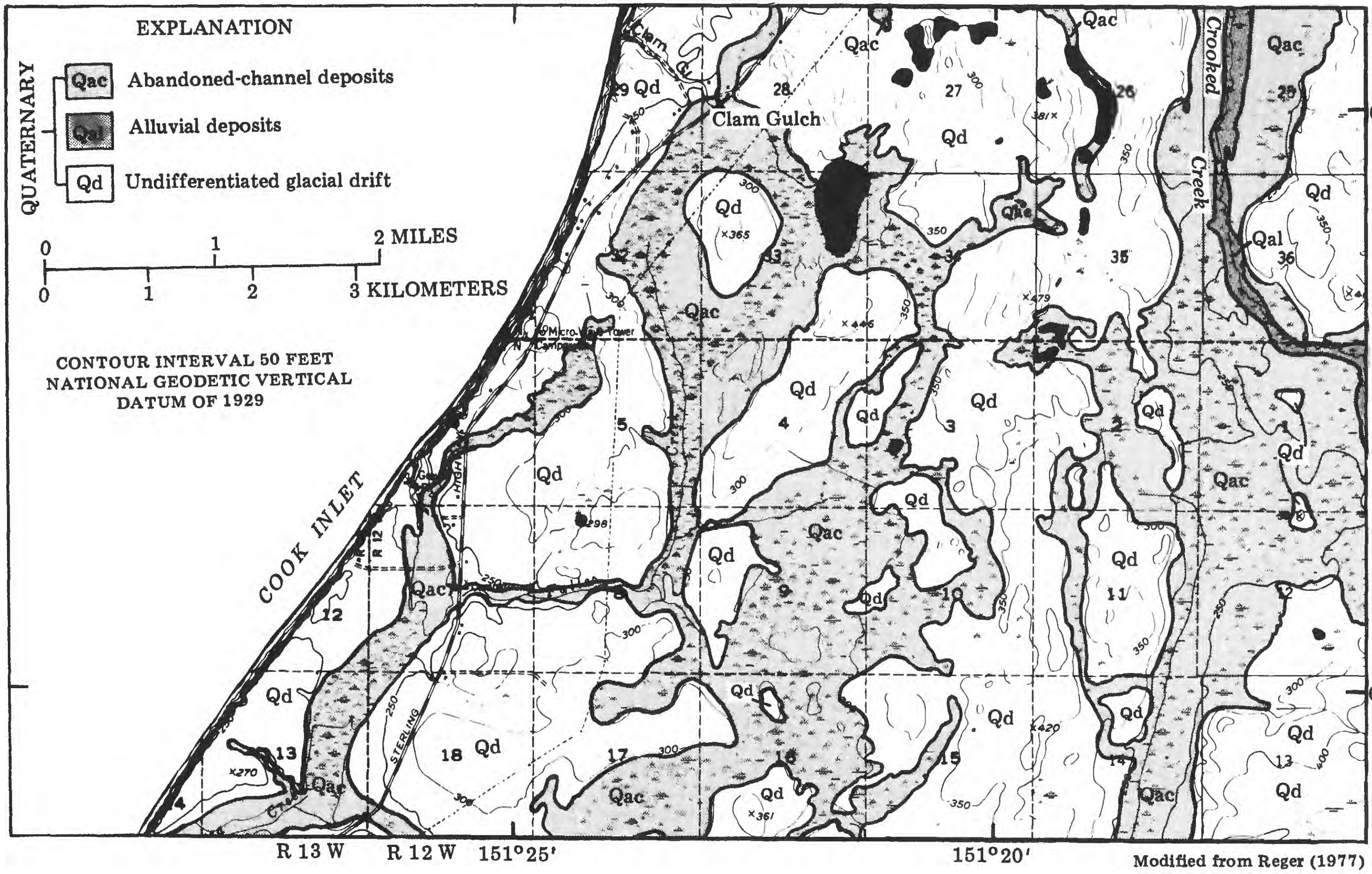


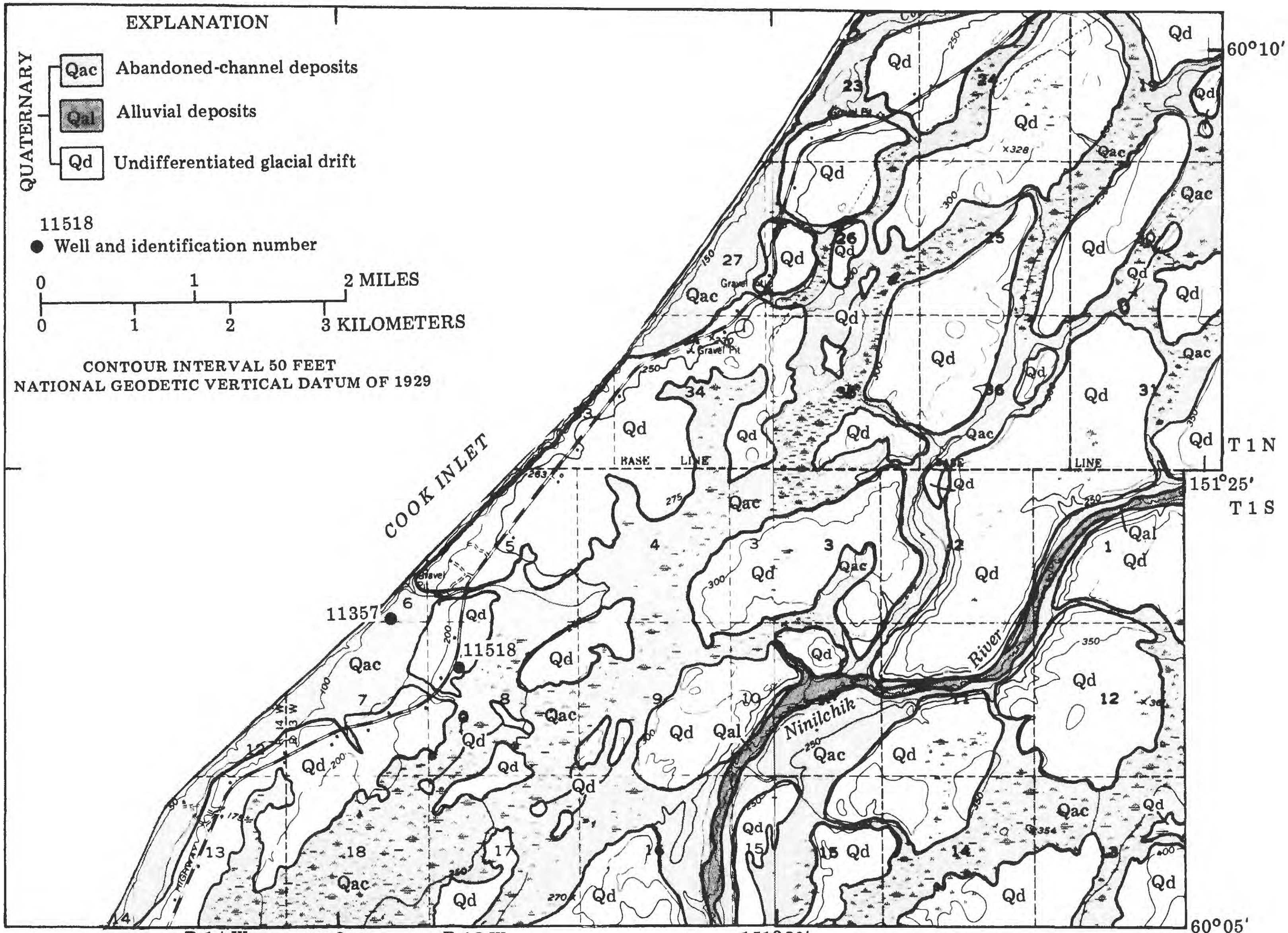
Figure 7.--Surficial geology of the Clam Gulch area.

UPPER NINILCHIK RIVER AREA

The upper Ninilchik River basin and adjacent coastal area (fig. 8) are sparsely settled. Few wells have been drilled in the area, and only two driller's logs are available.

The abandoned-channel deposits along Ninilchik River are a southerly extension of the Tustumena Glacier outwash channel discussed in the previous section. Wells in these deposits or the alluvium of Ninilchik River will induce recharge from the river and have good potential for yielding large supplies of ground water to wells. Less extensive abandoned-channel deposits in the area were deposited by small streams and are probably silty sand with minor gravel. The log of an oil well (well 11357, fig. 8) shows about 100 ft of unconsolidated materials. However, the log contains little lithologic detail because detailed logging is normally not performed on the upper few hundred feet of an oil well.

Drift deposits along the highways are probably too thin to be hydrologically significant, and wells in these areas will be completed in the bedrock. Well 11518 (fig. 8) penetrated only 4 ft of unconsolidated material over bedrock.



Modified from Reger (1977)

Figure 8.--Surficial geology of the upper Ninilchik River area.

NINILCHIK AREA

The Ninilchik area (fig. 9) is underlain primarily by glacial drift and abandoned-channel deposits. These deposits have been incised by Deep Creek and Ninilchik River, along both of which are alluvial deposits.

Glacier-fed streams flowed down the present courses of Ninilchik River and Deep Creek and deposited sediments in a broad alluvial plain southwest of the big bend in the Ninilchik River. This alluvial plain consists of coalescing abandoned-channel deposits and may be a delta. A well in the alluvial plain (well 11470, figs. 9 and 10) penetrated interlayered gravel, clay, and sand and was completed in medium to coarse sand that is confined by an 8-ft-thick clay layer. Several other wells drilled in the alluvial plain south of the Ninilchik area show similar materials. Although the materials throughout the alluvial plain probably consist of interlayered gravel, sand, silt, and clay, the stratigraphy is probably not uniform. Aquifers may be either confined or unconfined, depending on the distribution of confining beds within the local stratigraphic sequence.

Abandoned-channel deposits also occupy valleys between moraines. These deposits have low relief and poor drainage and are mantled by swamp deposits. A well in such deposits (well 10666, fig. 9) penetrated 48 ft of clay, sand, and gravel and was completed in bedrock at 308 ft. However, it is not clear from the log whether the materials penetrated are stratified (fluvial materials) or unstratified till. Therefore, the abandoned-channel deposit may be either 48 ft thick, or its thickness may be negligible and it overlies till. The well was completed in bedrock. By analogy with other parts of the lowlands, most abandoned-channel deposits in the small intermorainal valleys probably consist of silty sand, and their potential for supplying water to wells is less than the potential of the main outwash channels along the present channels of Deep Creek and Ninilchik River.

Moraines in much of the area are well drained except in topographic depressions and are the sites of much of the residential development. Most wells drilled in drift have been completed in the underlying bedrock in order to obtain an adequate supply of water. However, a 52-ft-deep test well (well 11636, fig. 10) in Deep Creek Estates obtained 20 gal/min from sand and gravel within the drift. A second test well (well 11635, fig. 10) was drilled about 20 ft from the first and penetrated bedrock at 74 ft. The second well, completed as an open hole in bedrock, also yielded about 20 gal/min. The 22-ft difference in head between the unconsolidated aquifer and the bedrock aquifer indicates that ground water is flowing downward and that Deep Creek Estates is an area of ground-water recharge.

Alluvium deposited by the existing streams occurs under active flood plains and in low terraces adjacent to flood plains. No reliable estimate of the thickness of the alluvium exists because there are no wells in the unit. Shallow wells that induce infiltration from streams are possible if the saturated alluvium is thick enough to permit wells to be completed in it.

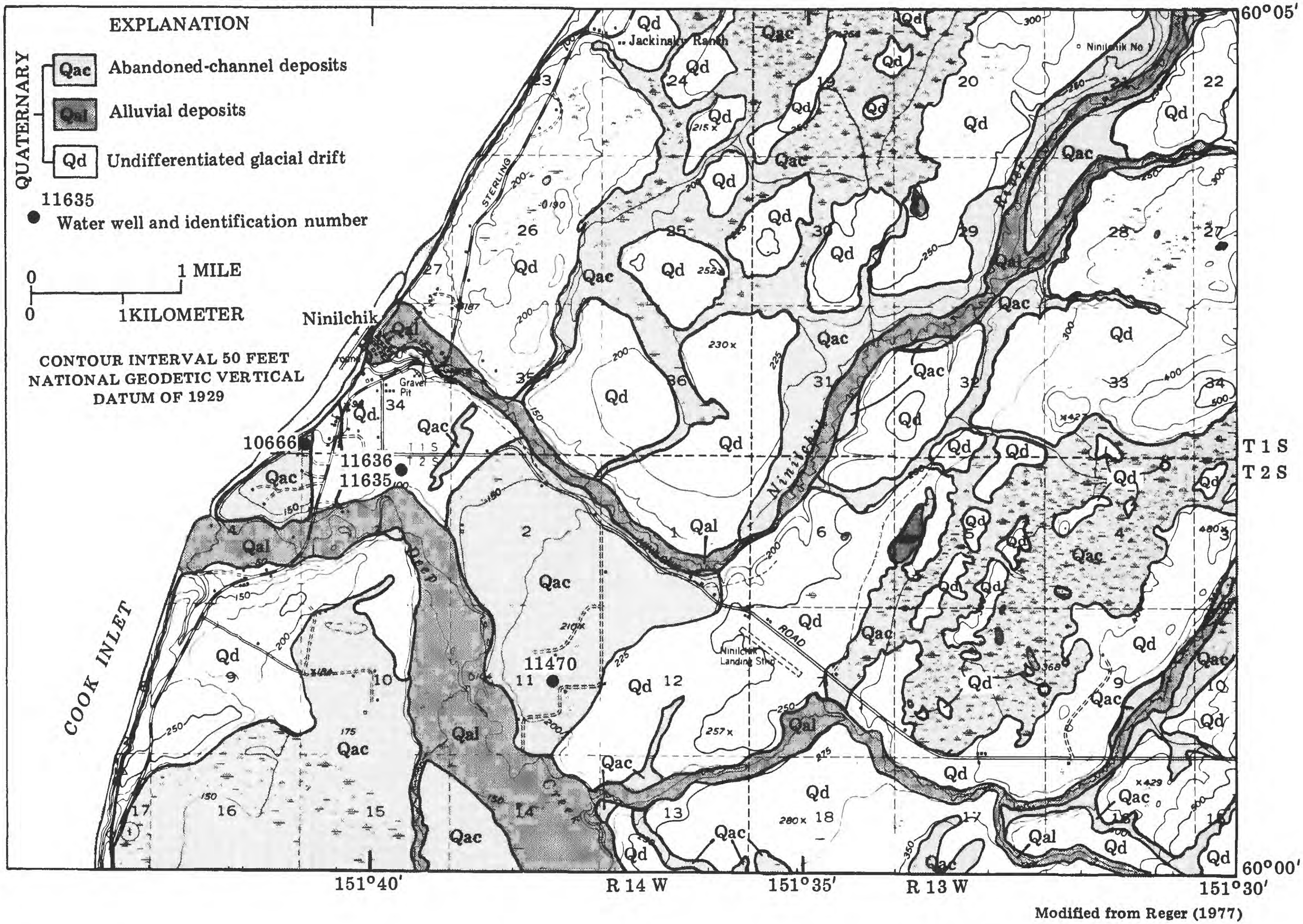


Figure 9.--Surficial geology of the Ninilchik area.

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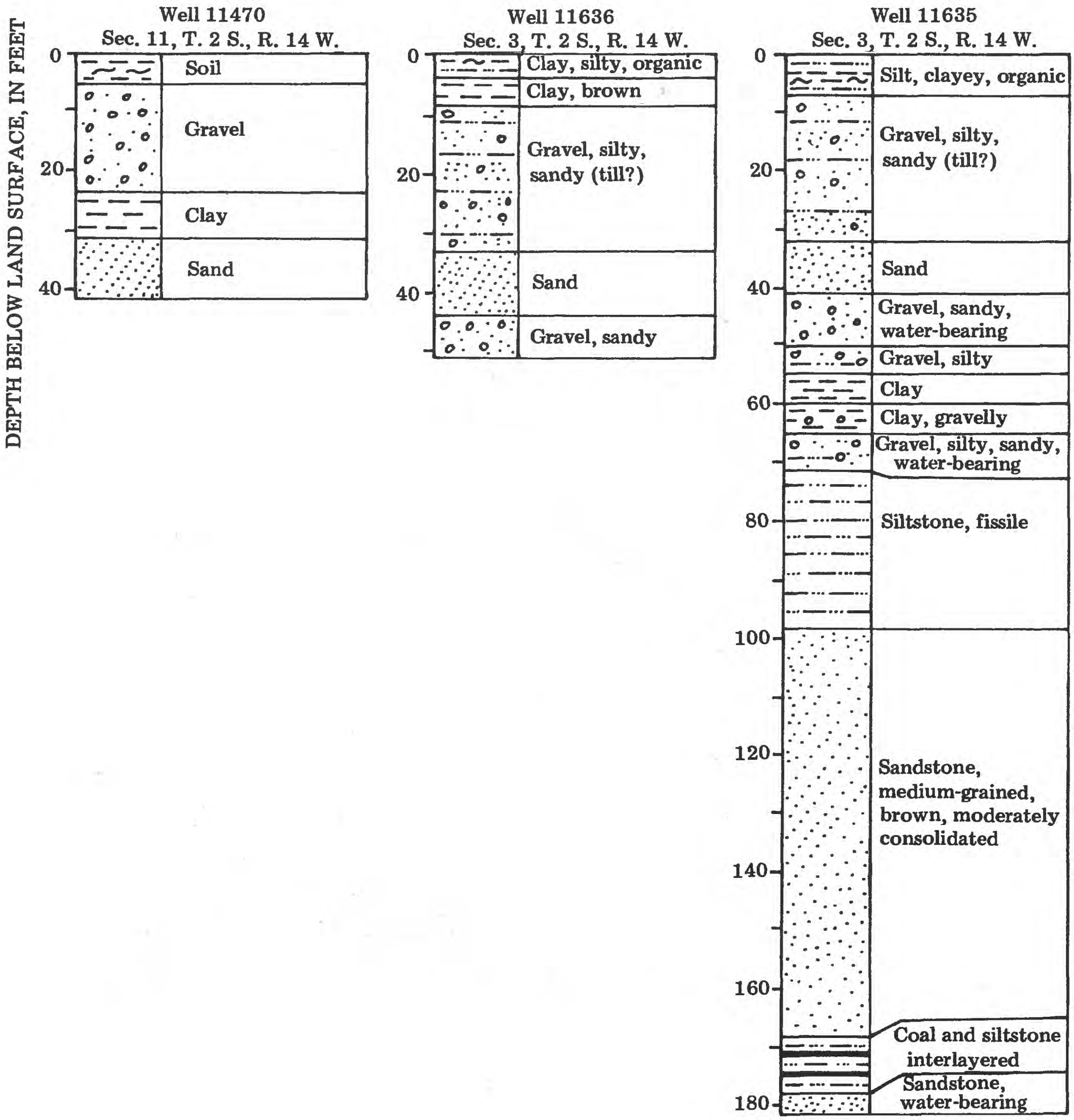
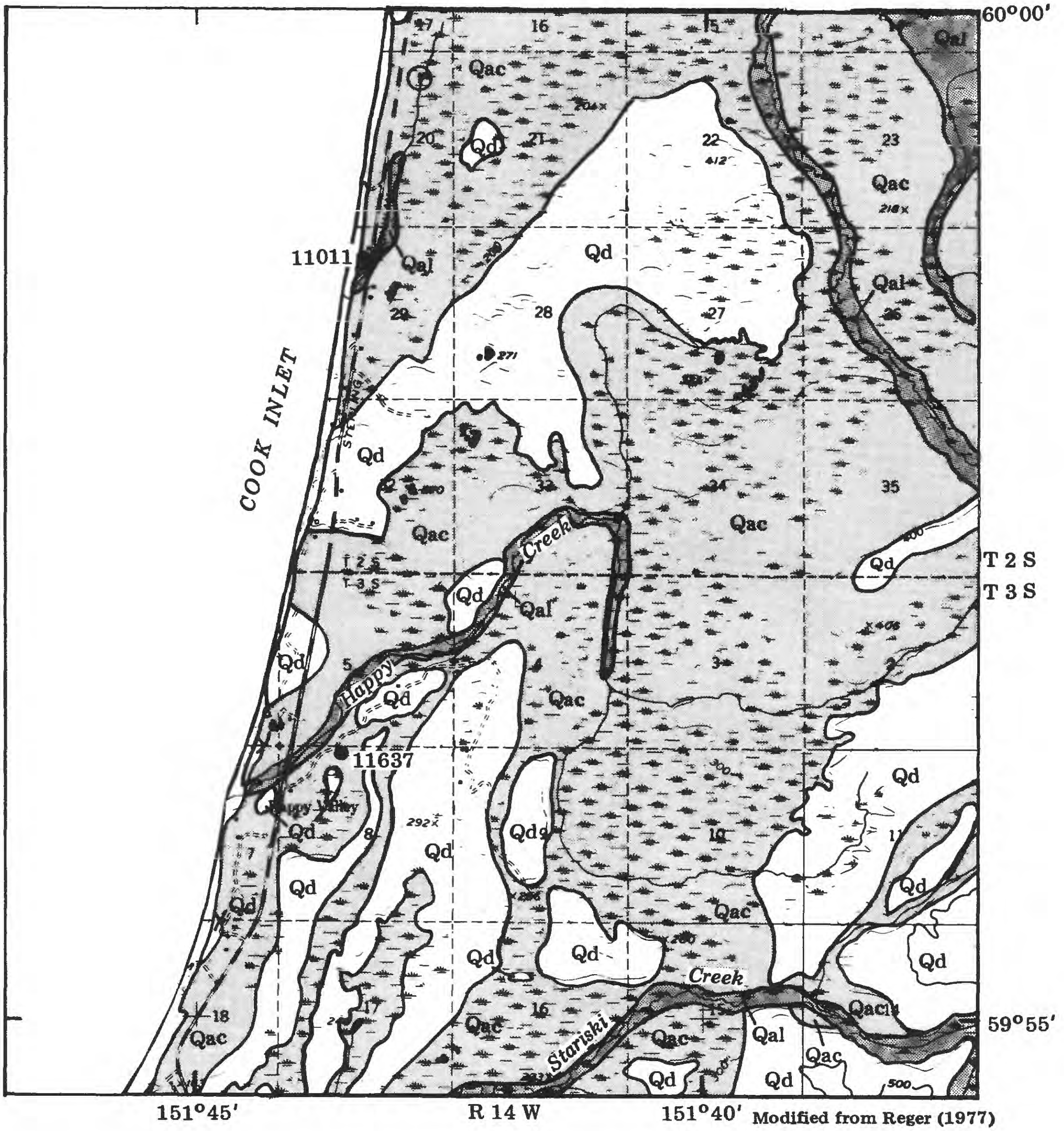


Figure 10.--Logs of selected wells in the Ninilchik area. Locations of wells are shown in figure 9.



EXPLANATION

QUATERNARY
- Qac — Abandoned-channel deposits
- Qal — Alluvial deposits
- Qd — Undifferentiated glacial drift

● 11011 Water well and identification number

0 1 2 MILES
0 1 2 3 KILOMETERS

CONTOUR INTERVAL 50 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Figure 11.--Surficial geology of the Happy Valley area.

HAPPY VALLEY AREA

The Happy Valley area (fig. 11) is underlain largely by an alluvial plain between two northeast-trending moraines. No logs are available from wells in the moraines, but aerial-photograph interpretations suggest that most of the glacial drift is composed of till and will yield little water to wells. Wells drilled in till would probably have to be completed in underlying bedrock in order to obtain an adequate yield.

The alluvial plain is a southward extension of the coalescing abandoned-channel system described in the Ninilchik area. Wells drilled in the plain are generally less than 30 ft deep and penetrate only sand and gravel. An exception is well 11011 (fig. 12) that penetrated 20 ft of unsaturated gravel overlying sandstone bedrock. The well was completed in a coal seam at 95 ft.

Wells in the less extensive abandoned-channel deposits penetrate interlayered sand, silt, clay, and minor amounts of gravel. Test well 11637 south of Happy Creek (fig. 12) penetrated abandoned-channel deposits that are typical of the Happy Valley area. The well was completed in the upper 25 ft of bedrock because the overlying sand, although it was water bearing, was too fine for the well to be completed without a screen.

Alluvium deposited by existing streams overlies and is hydraulically continuous with permeable abandoned-channel deposits of the alluvial plain. Pumping from either the alluvial deposits or the abandoned-channel deposits adjacent to the streams is likely to induce recharge from the streams.

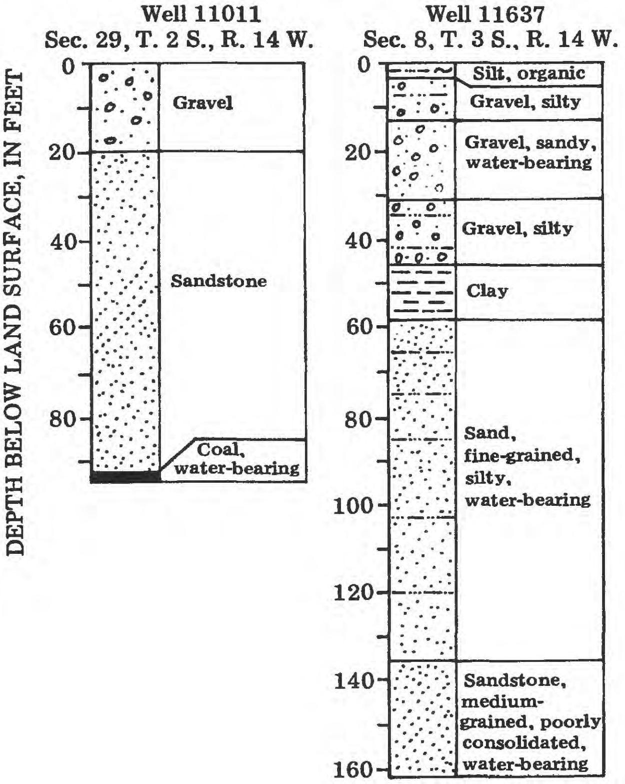


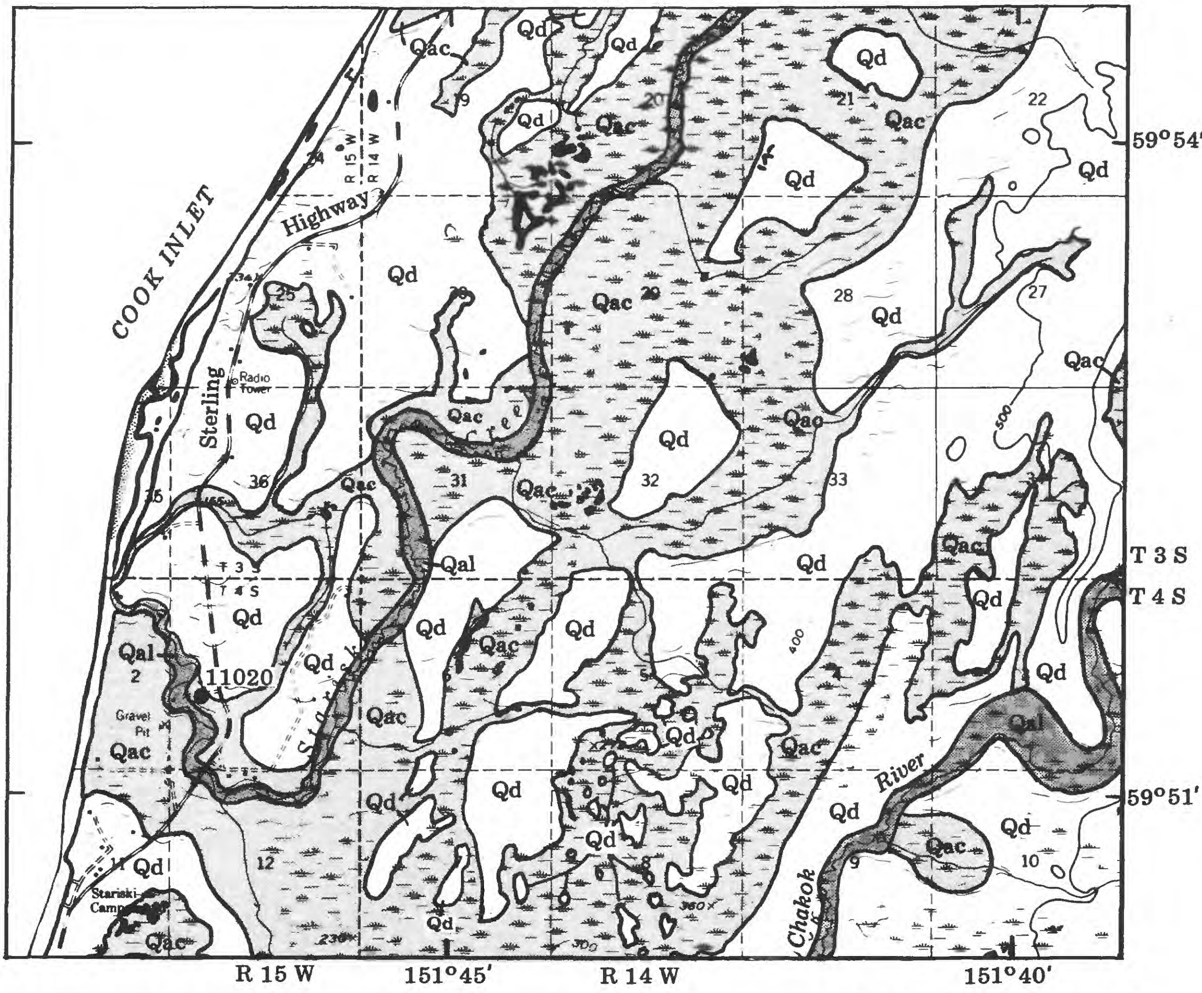
Figure 12.--Logs of selected wells in the Happy Valley area. Locations of wells are shown in figure 11.

STARISKI CREEK AREA

Glacial drift along the Sterling Highway south of Stariski Creek (fig. 13) is a thin veneer on low hills and fills topographic depressions. Five wells in sec. 11, T. 4 S., R. 15 W. are completed in sedimentary bedrock that is composed of poorly consolidated claystone with interlayered siltstone, sandstone, and coal. Most bedrock wells are 50-100 ft deep, but one was drilled to 353 ft in order to obtain an adequate domestic supply of water.

No wells have been drilled in the alluvial deposits of Stariski or Chakok Creeks. However, the streams appear to have been incising in geologically recent times, and their alluvial aquifers are probably thin.

Only one well in this area is drilled in abandoned-channel deposits (well 11020, fig. 13). It penetrates interlayered clay, silt, sand, and gravel to a depth of 80 ft, but it is not possible to tell whether the well penetrated bedrock. The well log shows materials that are typical of abandoned-channel deposits interlayered with marine or proglacial lake sediments, but that are also similar to the bedrock materials penetrated by wells in sec. 11, T. 4 S, R. 15 W.



Modified from Reger (1977)

EXPLANATION

QUATERNARY

- Qac — Abandoned-channel deposits
- Qal — Alluvial deposits
- Qd — Undifferentiated glacial drift

11020
● Water well and identification number

0 1 2 MILES
0 1 2 3 KILOMETERS

CONTOUR INTERVAL 50 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Figure 13.--Surficial geology of the Stariski Creek area.

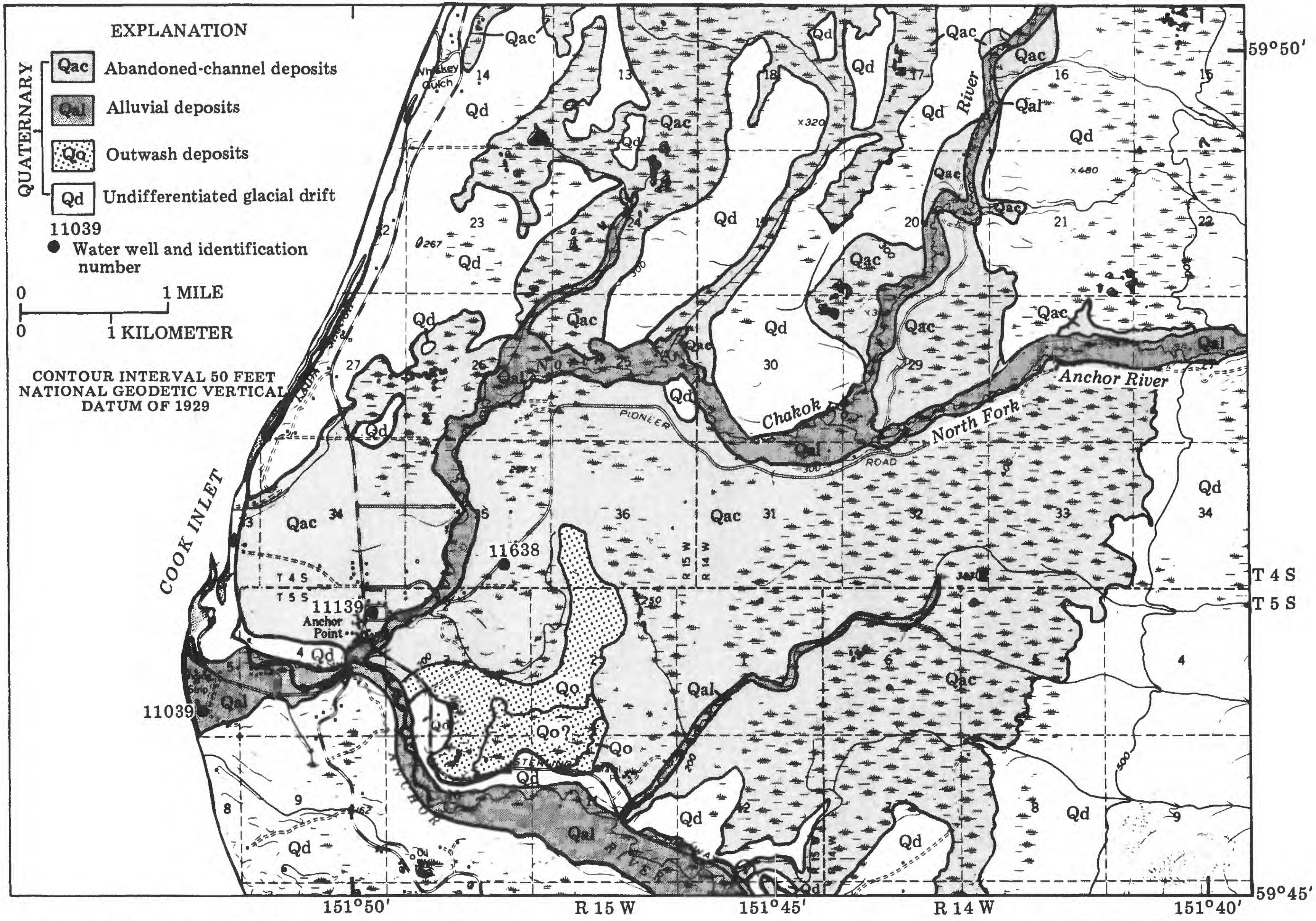


Figure 14.--Surficial geology of the Anchor Point area.

ANCHOR POINT AREA

South of the Anchor River (fig. 14) glacial drift is generally less than 20 ft thick. It is thickest where it fills topographic depressions and is thin on hilltops. Wells in the drift are generally completed in poorly consolidated sandstone or conglomerate.

Immediately north of the Anchor River is an alluvial plain consisting of outwash and abandoned-channel deposits. These alluvial materials are thickest near the town of Anchor Point and consist of interlayered sand and gravel (well 11139, fig. 15). The materials become more fine grained and thinner to the east (well 11638, fig. 15), where wells are generally completed in bedrock.

North and east of the alluvial plain are undifferentiated drift and intermorainal abandoned-channel deposits that are similar to those described from the Stariski Creek area. The drift is too thin to be a source of water to wells, and wells are completed in bedrock.

Alluvial deposits of both Anchor River and the North Fork of Anchor River appear to be generally too thin to yield enough water to domestic wells. A well drilled in the Anchor River alluvium 0.5 mi south of the study area penetrated only a few feet of flood-plain silt over bedrock. However, within 1 mi of the coast, the stream valley broadens, and the river has aggraded its channel. In this area, well 11039 (fig. 15) obtained a domestic supply of water from alluvium at a depth of 19 ft.

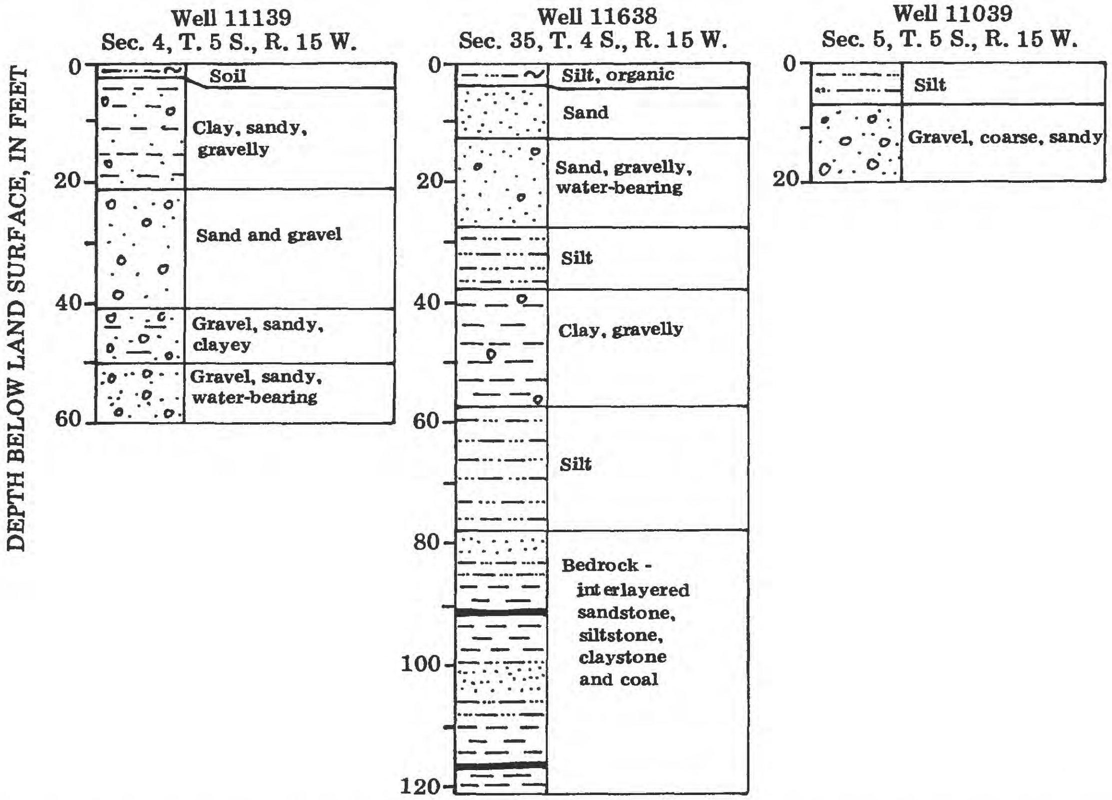


Figure 15.--Logs of selected wells in the Anchor Point area. Locations of wells are shown in figure 14.

UPLANDS AREA

Unconsolidated materials in the uplands area are, with few exceptions, too thin to provide water to wells. Throughout this area, bedrock is the major aquifer. Possible exceptions are several postulated outwash deposits at altitudes greater than 1,000 ft in the uplands (fig. 16) that were mapped by Karlstrom (1964). These deposits may have been deposited by streams originating from glacier lobes that moved into the passes in the uplands from a large glacier in the Fox River valley. However, deposits have not been drilled, and their fluvial origin has not been confirmed. They are probably too thin to provide enough water for domestic wells.

All wells for which logs are available are near the southeast corner of the uplands area. These wells are in bedrock, which consists of interlayered sandstone, siltstone, claystone, and coal. The wells are generally completed in poorly consolidated sandstone, but one is completed in coal. The well depths range from 47 to 452 ft; most are less than 200 ft.

CONCLUSIONS

Poorly consolidated sediments of the Kenai Group are the principal source of ground water in the study area. However, sparse data preclude defining the distribution of aquifers in the Kenai Group.

Surficial deposits with the best potential for developing significant ground-water supplies are the deltaic complex near the mouth of Kasilof River and the alluvium of Crooked Creek. Alluvium in a major abandoned drainageway of Tustumena Glacier has good potential for ground-water development. Other abandoned-channel deposits also show good potential for ground-water development, particularly where the deposits are part of a large alluvial plain or where they are in communication with streams. Pumping of ground water from materials that are in hydraulic communication with streams will induce infiltration of streamflow and decrease stream discharge.

In most areas, a single well will probably not yield large municipal or industrial supplies (more than 1 million gal/d), and well fields will probably be required for such large quantities.

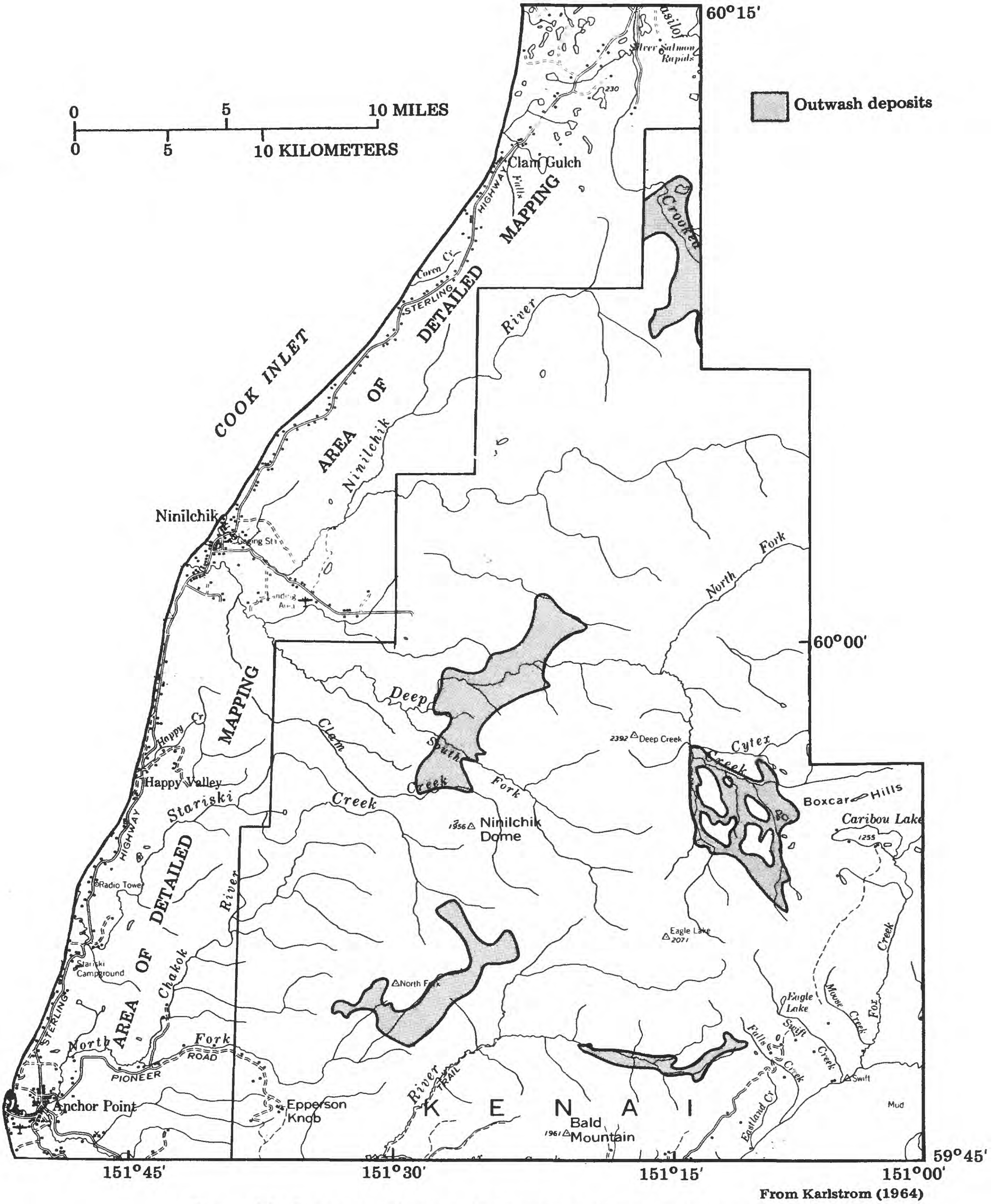


Figure 16.--Location of outwash deposits in the uplands area.

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