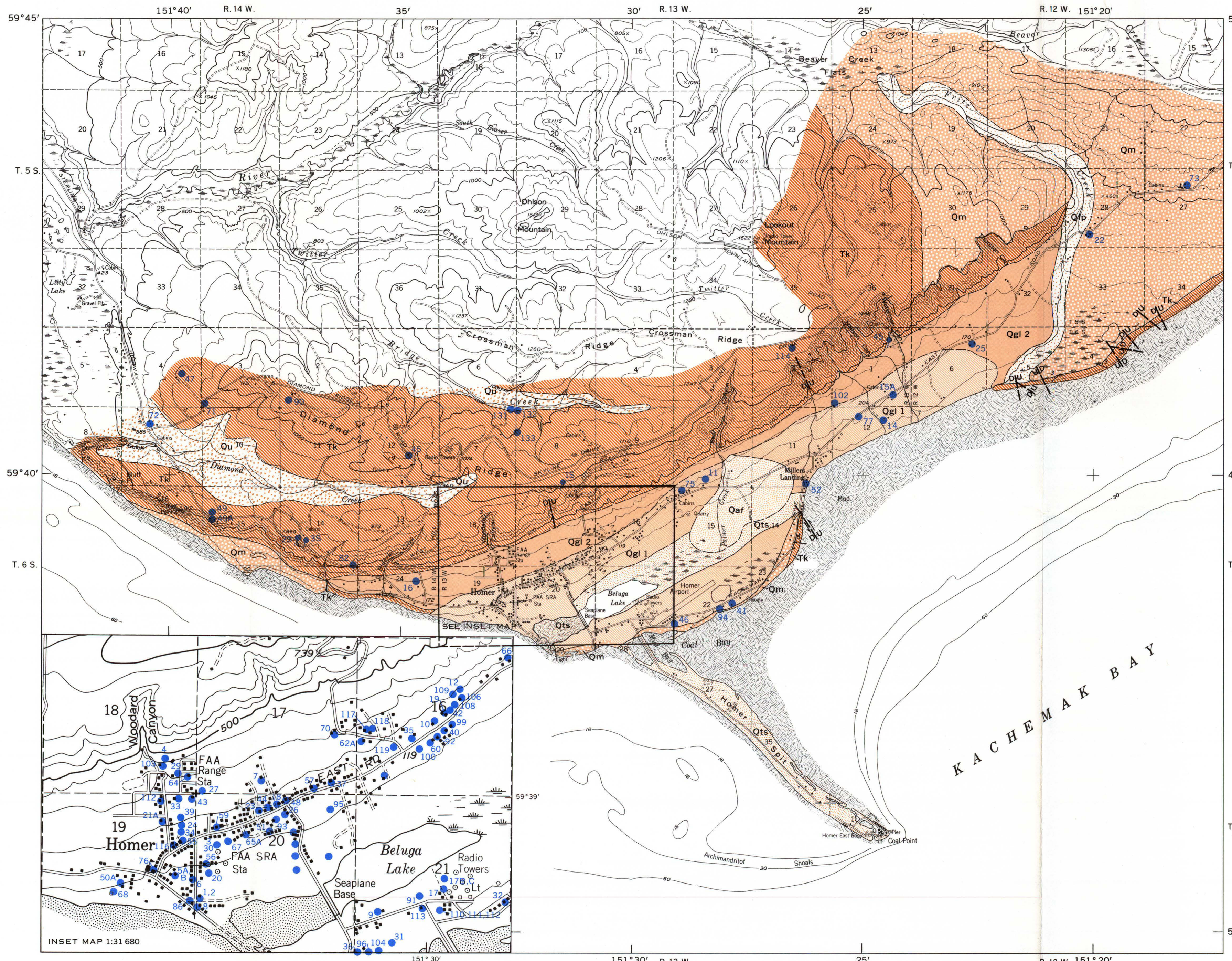


Base from U.S. Geological Survey Topographic quadrangles 1948–1952

SCALE 1:63 360

CONTOUR INTERVAL 100 FEET
DATUM IS MEAN SEA LEVEL

Geology after Barnes and Cobb (1959) and Karlstrom (1964)

SURFICIAL GEOLOGIC MAP SHOWING LOCATION OF WELLS AND SPRINGS

EXPLANATION

QUATERNARY

Recent

Qfp — Flood-plain deposits
Silt, sand, and gravel in channels, valley floors, and low terraces. May yield 5 gpm of water to shallow wells

Qaf — Alluvial-fan deposits
Poorly sorted sand and silt. May yield 25 gpm of water to shallow wells

Qts — Elevated tidal silt and beach deposits
Silt and organic material adjacent to Beluga Lake; well-sorted beach gravel and sand on Homer Spit; postglacial. Yields only saline and brackish water on the Homer Spit

Pleistocene

Qgl 1, Qgl 2 — Glaciolacustrine deposits
Qgl 1, *subunit 1, deposits more than 20 feet thick. Proglacial lake-bottom and deltaic sediments; principally poorly sorted clay and silt with sand at base of deposit in vicinity of Homer. Yields of 5 to 25 gpm of water may be expected from the sands*
Qgl 2, *subunit 2, deposits less than 20 feet thick. Principally clay and colluvium. Occurs higher on benches. Virtually not water bearing*

Naptowne Glaciation

Qu — Undifferentiated deposits
Sand and gravel of Barnes and Cobb (1959); postglacial, may contain pre-Naptowne glacial drift redeposited in Naptowne or later time. Yield 5 to 10 gpm of water to shallow wells

Qm — Morainal deposits
Till, ice-contact, and outwash-stream deposits; formed during last glaciation of Homer area. Poor water-bearing formation except in local sand and gravel beds where yields of 10 to 20 gpm may be obtained

TERTIARY

Oligocene(?), Miocene, and Pliocene

Tk — Kenai Formation
Interbedded poorly consolidated sandstone, siltstone, and claystone, with minor amounts of conglomerate. Contains many beds of subbituminous coal and lignite. The most extensive and best potential aquifer in the Homer area

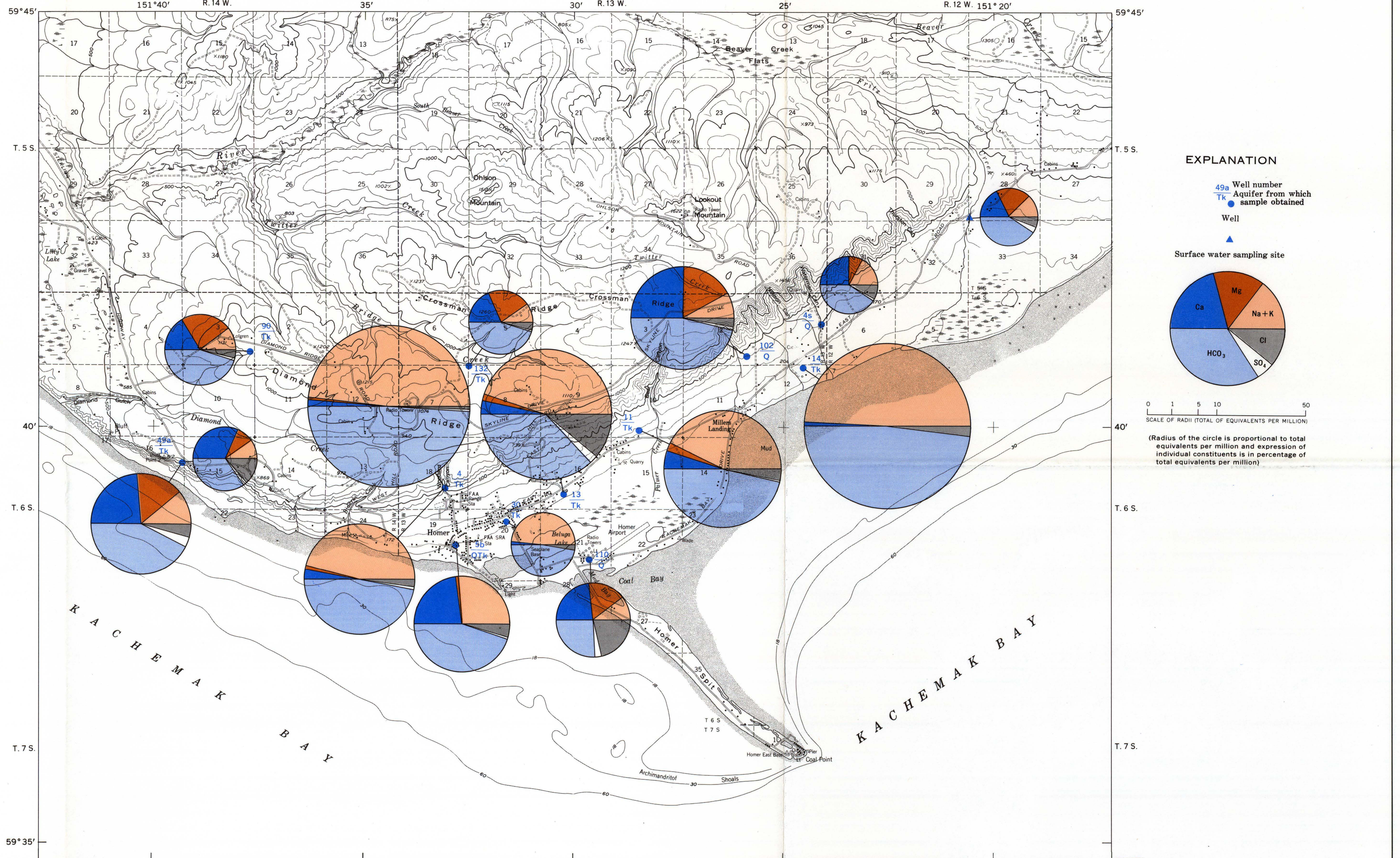
Contact
Dashed where inferred

Fault, approximately located
Arrows show relative direction of displacement. U, *upthrown side;* D, *downthrown side*

Strike and dip of beds

Well or test hole
Number corresponds to those in text

Spring
Number corresponds to those in text



Base from U.S. Geological Survey Topographic quadrangles 1948–1952

SCALE 1:63 360

CONTOUR INTERVAL 100 FEET
DATUM IS MEAN SEA LEVEL

MAP SHOWING WATER QUALITY FROM SELECTED SURFACE AND GROUND WATER SOURCES

INTRODUCTION

Development of ground water in the Homer area is limited by objectionable amounts of iron in solution and by small yields available to individual wells. Because surface-water supplies are located in areas that are distant from the population center, development would be costly.

In 1960, the U.S. Geological Survey began a reconnaissance study to provide information relating to the water problems of the Homer area. This report briefly discusses the geohydrology of the area and the possibility of future ground-water development. Mapping and descriptions of geologic formations are largely from published reports. Modifications of the formation boundaries in the Homer bench area were made by the senior author. Appreciation is expressed to well owners and drillers for information. F. H. and A. H. Thorn supplied most of the well logs used in interpretation of subsurface geology.

GEOGRAPHIC SETTING

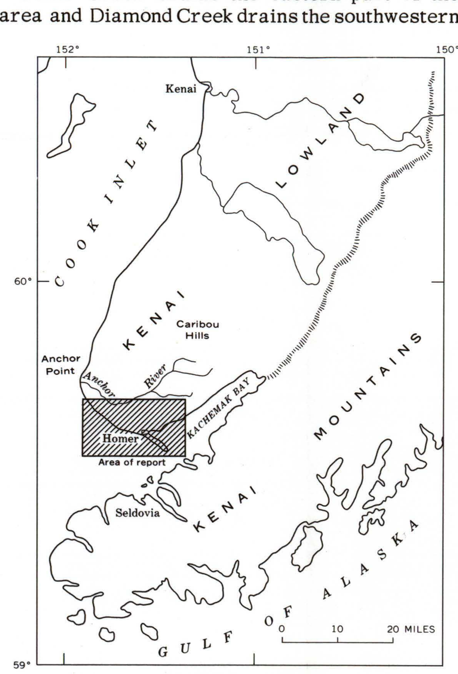
The Homer area lies at the southern end of the Kenai Peninsula between Cook Inlet and the Kenai Mountains. (See index map) The area includes the Homer Spit, which extends 4 miles into Kachemak Bay, two benches, and the adjoining escarpment. The escarpment extends from the mouth of Diamond Creek on the west to Fritz Creek on the east. Altitude of the escarpment ranges from more than 1,000 feet to sea level. North of the escarpment crest the upland lies at altitudes generally higher than 750 feet. The principal features of the area are shown on the oblique aerial photograph. Their relationship to geology is shown on the diagrammatic section.

Fritz Creek drains the eastern part of the area and Diamond Creek drains the southwestern part. Numerous small creeks that head in the escarpment flow southward into Beluga Mudlake or Kachemak Bay. In the northern part of the area, Bridge Creek and Twitter Creek drain into the Anchor River, the principal drainage system immediately north of the Homer area.

The area surrounding Beluga Mudlake and other parts of the lower bench are covered with muskeg and stunted spruce forest. Dense spruce and alder forests occur in scattered areas of the uplands.

The population of the area is about 1,200, most of whom are engaged in seasonal commercial fishing, seafood processing, and agriculture. Industry is concentrated at the end of the Homer Spit; homes and businesses are scattered along the lower bench and along the lower slope of the escarpment.

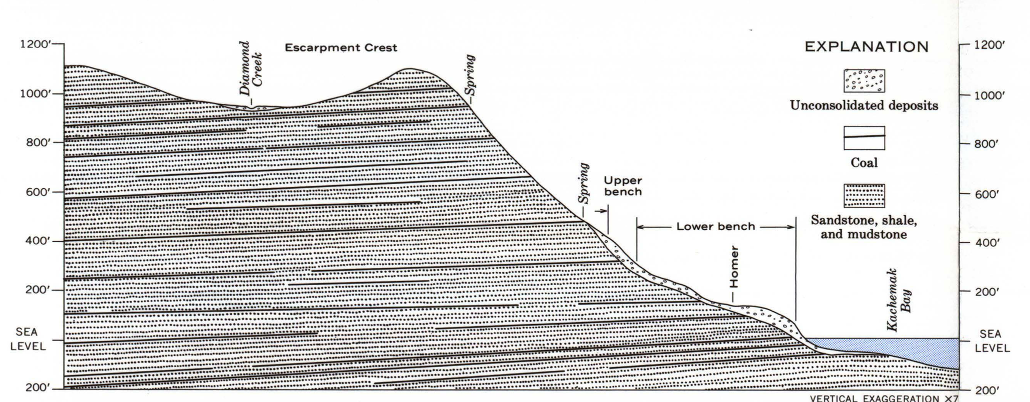
The Homer area is accessible by boat, automobile, or airplane. The Sterling Highway from Anchorage offers the best means of reaching the area apart from air travel, although a ferry service from Anchorage via Kodiak visits the area twice a week. The area is served by regular flights on an airline route from Anchorage to southwestern Alaska.



INDEX MAP

Mac's Foto, Anchorage

OBLIQUE AERIAL PHOTOGRAPH OF THE HOMER AREA



DIAGRAMMATIC SECTION SHOWING RELATIVE POSITION OF THE MAJOR PHYSIOGRAPHIC AND GEOLOGIC UNITS

GEOLOGY

The surficial geologic map shows that rocks ranging in age from Tertiary to Recent are exposed within the three principal geomorphic units of the Homer area, the escarpment and adjacent upland, the bench area at the foot of the escarpment, and the Homer Spit. The escarpment is formed on generally northward dipping strata of the Kenai Formation of Tertiary age. The area, at the foot of the escarpment, consists of two benches, a lower bench which extends from about the 50-foot level to the 300-foot level, and an upper bench which extends from the 300-foot to the 400-foot level. The bench areas are composed of glacial, alluvial-fan, and colluvial deposits of Quaternary age that unconformably overlie Tertiary rocks. The Homer Spit is composed of well-sorted Recent bench deposits overlying marine and glaciolacustrine sediments of Pleistocene age.

TERTIARY SYSTEM

Oligocene(?), Miocene, and Pliocene Series

Kenai Formation

The Kenai Formation, which underlies the entire Homer area, consists of moderately indurated sand, silt, and clay, generally in thin beds and lenses, interbedded with a few thin lenses of fine conglomerate and many thin beds of subbituminous or lignitic coal. Many fine-grained sandstone sequences containing ferruginous masses or ironstone concretions in distinct bands and as scattered nodules are common throughout the formation. The thickness of the Kenai Formation at Homer is unknown. However, an oil-test well drilled by Occidental Petroleum Co.—South Diamond Gulch No. 1 (sec. 6, T. 6 S., R. 14 W.), just northwest of the study area, drilled through 10, 568 feet of the Kenai Formation. The age of the formation is considered by Wolfe, Hopkins and Leopold (1966) to be late Oligocene(?), Miocene, and Pliocene on the basis of its flora.

QUATERNARY SYSTEM

Pleistocene and Recent Series

The Pleistocene history of the Homer area is quite complex. According to Karlstrom (1964), the area probably has been glaciated several times. The area north of the escarpment crest is covered by deposits of the Eklutna Glaciation; whereas deposits of the Naptowne Glaciation occur in the area east of Homer and along the escarpment face. Most of these deposits are thin and are therefore mapped generally as bedrock of the Kenai Formation after Barnes and Cobb (1959, pl. 17).

One of the oldest Quaternary deposits in the area is the Pleistocene morainal deposits of Naptowne Glaciation, which occurs extensively in the eastern part of the study area. The moraines are thin deposits of interbedded sand and gravel.

Undifferentiated Quaternary deposits, which are considered to be Pleistocene in age, occur in the northern and western parts of the area. These deposits may contain pre-Naptowne glacial drift that has been eroded and redeposited, probably in Naptowne or later Pleistocene time.

Glaciolacustrine deposits of Pleistocene age range in thickness from less than 10 to more than 60 feet in the bench area near Beluga Mudlake. South of Beluga Mudlake the deposits are represented by coarse well-sorted sand and gravel that appear to have been deposited near ice by running water and later disturbed by ice movement. West of the airport, well records indicate poorly sorted deposits. Where these deposits attain a thickness of more than 20 feet, they have been mapped as subunit 1. Where the deposits are less than 20 feet in thickness, they are mapped as subunit 2. East and north of Beluga Mudlake, the lacustrine clays thin and become indistinguishable from the colluvium and clayey till deposits.

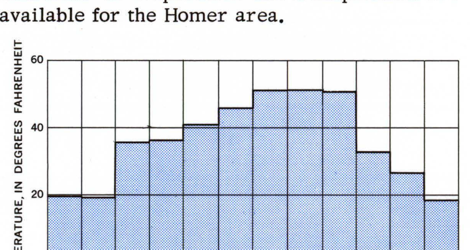
Unexposed deposits of probable Pleistocene age underlie thin Recent surficial deposits of the Homer Spit. Test drilling on the Spit has indicated about 300 feet of sediments of glaciofluvial origin. These deposits probably are related, in the upper 200 feet at least, to the thick deposits of glacial material underlying the area at Homer. The lower 100 feet contains increasing amounts of clay with sand and gravel beds.

Two coalescing alluvial fans at the eastern end of Beluga Mudlake consist of sand and gravel of postglacial age. The thickness of this deposit is unknown but probably is small.

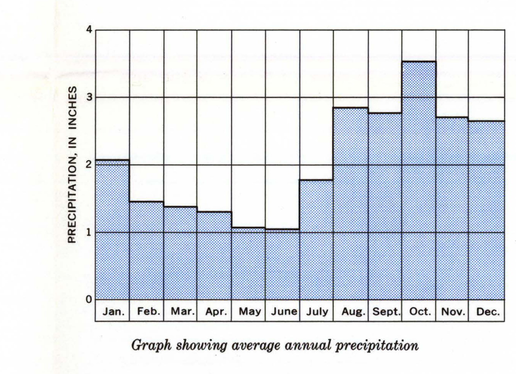
Flood-plain deposits which occur in the valley of Fritz Creek and in a few other creeks consist of silt, sand, and gravel of post-glacial age. The deposits are mappable only in the Fritz Creek area; there they are generally less than 5 feet thick.

AVAILABILITY OF WATER

Water in the Homer area, both surface and ground water, is derived from rainfall and snowmelt. Reports by the U.S. Weather Bureau (1961) show a maritime climate characterized by minimum precipitation during the spring months and maximum precipitation during the months of August through December. (See temperature and precipitation graphs). Annual precipitation is about 23 inches at the airport and is about 28 inches on the upland above the escarpment at an altitude of 1,000 feet. During the months of May, June, and July, precipitation is deficient and evaporation and transpiration are believed to be high. Total recharge in the area is estimated to be about 5 inches per year, about one-fifth of the total average annual precipitation. No determinations of evaporation and transpiration are available for the Homer area.



Graph showing average annual temperature



Graph showing average annual precipitation

Surface Water

Few data are available on the discharge of streams in the immediate area of Homer. Two measurements were made on Fritz Creek and on Diamond Creek in May 1962. Because the measurements were made during the period of high flow in these streams, the results cannot be correlated with the annual streamflow patterns of the area. Discharges recorded are:

	May 2	May 18
Fritz Creek	20.1 cfs (13.0 mgd)	34.4 cfs (22.2 mgd)
Diamond Creek	20.8 cfs (13.4 mgd)	16.3 cfs (10.5 mgd)

Streamflow records are available on the Anchor River 1 mile upstream from the mouth (drainage area 226 square miles). These records show an average discharge for a 12 year period of 298 cfs (cubic feet per second) or 193 mgd (million gallons per day); minimum discharge for the period was 28 cfs or 18 mgd.

The use of surface water at Homer does not appear to be practical at the present time. Use of streamflow would involve long supply lines and possibly reservoirs for the retention of water during winter months. However, additional development in the area may require future consideration of this source of water to supplement ground-water supplies.

Ground Water

The Kenai Formation probably constitutes the most extensive and the most productive aquifer system in the study area. Ground water is available to drilled wells throughout the area. Most of the wells drilled along the bench area yield less than 10 gpm (gallons per minute), although none of the wells drilled were tested to their fullest extent. A larger yield was obtained from well 4 at the Homer hospital, which penetrated 22 feet of sand. The lower 10 feet of the aquifer was screened and the well produced about 20 gpm with about 80 feet of drawdown. This gives a specific capacity of about 0.25 gpm per foot of drawdown, the largest recorded yield per foot of drawdown in the Kenai Formation in the bench area. Most wells drilled in the bench area are not screened and further testing is warranted.

Wells drilled into the Kenai Formation in the upland north of the escarpment crest have considerably larger yields. A test well (well 132) adjacent to Bridge Creek, drilled for the city of Homer in 1966, produced about 80 gpm with about 80 feet of drawdown, giving a specific capacity of 1 gpm per foot of drawdown. Other tests in this area indicate that withdrawals of 50 to 100 gpm may be possible. Many springs and seeps flow from the exposed beds of the Kenai Formation along the escarpment face above Homer. The average yield of these springs is about 2 gpm. The springs provide additional ground-water recharge to the Quaternary deposits on the lower bench.

The yield of Quaternary deposits of sand and gravel in the glaciolacustrine areas of the lower bench (Qgl) is comparable to the yields of the Kenai Formation. Most wells in these glacial deposits have yields of from 5 to 25 gpm. However, a yield of 70 gpm was reported for well 51 at the Bearfoot Trailer Court in 1959.

The glaciofluvial deposits underlying the Homer Spit area apparently do not contain fresh ground water. All test wells drilled to date on the Spit have produced salty water. The deepest test well drilled on the Spit (490 feet) ended in clay and sandstone, probably of the Kenai Formation.

Table of water analyses from selected surface and ground-water sources (Analyses by the U.S. Geological Survey-chemical concentrations in parts per million)

Township range, section, and ¼ section locations	Well no.	Date of collection	Depth of well (feet)	Silica (SiO_2)	Total iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180° C)	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25° C)	pH	Color
6S 13W 18 NWSESE	4	9-14-62	112	26	0.12[1]	0.01	8.0	1.0	292	4.4	772	4.0	6.0	0.0	0.6	735	24		1130	8.5	
18 NWSESE	4	12-20-62	195	50	0.9	.00	6.4	1.0	117	6.3	310	2.0	8.5	.2	.2	348	20		497	8.3	20
1 SENWNE	4S	4-24-63	Spring	37	.02	.00	14	2.9	9.6	3.1	72	1.0	8.5	.2	.2	112	48		160	7.0	5
19 NWNESE	5b	6-10-55	107	31	4.6	.64	39	4.9	40	2.9	226	.7	14	.0	.4	246	117		390	7.6	
10 SESESW	11	3-28-63	72	40	6.8		13	3.8	127	3.4	354	4.0	14	.2	.8	383	48		545	7.5	
16 NESWSW	13	4-24-63	80	21	1.9	.00	2.4	1.0	40	1.0	88	3.0	16	.1	.7	130	10		177	6.9	80
12 SENWNE	14	12-14-62	187	17	.72[1]	.00	4.0	.0	308	4.0	800	1.0	16	.2	.3	744	9		1150	7.2	
20 SENWNW	30	5-31-53	119	34	.59	.00	1.6	.0	184	2.4	466	.0	16	.1	.1	467	4		732	7.7	
6S 14W 15 NESWNW	49a	4- 4-60	73	40	11	.69	25	4.2	8.0	1.2	90	1.0	19	.2	.0	154	82		201	6.7	0
15 NESWNW	49a	5-31-63	247	37	8.5	.30	42	17	20	4.3	235	15	12	.0	.1	263	174		430	6.6	
6S 14W 2 SWSWSW	90	3-25-63	550	48	3.1	.30	15	13	7.0	6.4	112	1.0	6.0	.3	8.0	170	103		247	7.0	25
6S 13W 1 SWSWSW	102	4-24-63	115	41	6.8	.89	49	21	12	8.2	270	6.0	11	.3	.2	283	206		446	6.8	40
21 SWNWSE	110	10-25-62	41	33	10	1.2	25	11	13	1.7	88	7.0	41	.1	.0	175	108		296	8.2	5
8 NWNWNW	132	6- 1-66	224	47	2.0[2]	-	14	10	5.1	5.0	110	1.4	6.4	0.1	0.3	144	90		190	7.0	10
	Fritz Creek	3-23-62	Creek	39	.10[1]	.00	11	7.2	7.6	2.8	80	5.0	6.0	.0	.2	118	23		143	7.1	

[1] In solution at time of analysis
[2] Field determination

QUALITY OF WATER

Ground water in the Homer area is typically of the sodium bicarbonate or calcium bicarbonate type, and in some areas contains as much as 30 ppm (parts per million) iron as well as combustible gas.

Selected chemical analyses, presented on the table of chemical analyses of waters, show that the ground water contains moderate amounts of dissolved solids and is probably suitable for most uses. The hardness ranges from extremely soft (well 30, 4 ppm) to very hard (well 102, 206 ppm). The soft water is generally obtained from the Tertiary Kenai Formation and the harder water from the Quaternary deposits. The pH of the water in the area ranges from 6.7 to 8.5, neither excessively acid nor excessively alkaline. Fluoride is generally found in small amounts but in concentrations too small to have any appreciable effect on the development of tooth enamel in growing children.

The water quality map shows pattern diagrams of the chemical types of waters in the Homer area and suggests distribution in relation to subsurface geologic units.

Objectionable amounts of iron occur in the ground water throughout much of the area. The highest iron concentrations, which average about 4 ppm, occur in water in the Quaternary deposits of the lowland; generally lower concentrations of iron are found in water from the Kenai Formation, especially in the upland area north of the escarpment crest. Although data are meager, there is some indication of a seasonal variation of iron concentration and a possible decrease of iron with pumping.

Treatment to remove the iron is usually needed before the water is suitable for domestic uses. An iron content of more than 0.3 ppm will give objectionable taste and stain laundry and cooking utensils (U.S. Public Health Service, 1962, p. 43). The iron is apparently ferrous iron which is readily soluble. Upon contact with air the ferrous iron oxidizes rapidly and precipitates as ferric hydroxide. Treatment by aeration followed by filtration removes much of the iron.

Ground water in some areas also contains methane gas probably derived from the coal formations. Its presence is noted here principally because of the hazards of its accidental ignition and its effect on future water-treatment practices. Gas is reported to be present in many wells during construction. Quite commonly, the gas can be ignited as it emerges from hot water taps in homes, especially in the morning after a night of nonuse. Serious accidents can occur if its presence is not recognized. Well drillers usually recommend venting gas-producing wells, but further precautions should be exercised in wells enclosed within buildings.

PROSPECTS FOR FUTURE DEVELOPMENT

In the past, moderate yields in the Homer area have been obtained from wells in the Kenai Formation and in the Quaternary deposits. Additional ground-water development, particularly of the Kenai Formation on the upland north of the escarpment crest, seems feasible. The city of Homer, in 1966, completed a test-drilling program near Bridge Creek. Yields of 50 to 80 gpm have been developed, and it seems probable that comparable yields can be obtained in the future from properly constructed and developed wells in favorable upland areas. The water is of good quality; the water contains only about 1-2 ppm iron (as compared to about 4 ppm from wells in the bench areas) and is low in dissolved solids.

In the future, consideration should be given to the conjunctive use of ground and surface water in the Homer area. The sources could be used alternately depending upon the season of the year. Although the annual range of streamflow is not known, it is probable that low flows during the winter months could be supplemented by the addition of relatively warm ground water which would be advantageous because it would prevent freezing of the distribution lines.

Additional study of surface water and its chemical quality will be required to adequately evaluate and plan conjunctive use of surface and ground water.

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WATER RESOURCES AND SURFICIAL GEOLOGY OF THE HOMER AREA, SOUTH-CENTRAL ALASKA

By
Roger M. Waller, Alvin J. Feulner, and
Donald A. Morris

1968

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